Food Safety: In a State of Transformation

Prepared by Cornerstone Capital Group for the Investor Responsibility Research Center Institute

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Please see important disclosures at the end of this report.
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Executive Summary

A number of highly publicized food scares have swept through the global food chain in recent years. Headlines include the outbreaks of *E. coli* and norovirus at Chipotle, *Salmonella* linked to Foster Farms poultry, melamine adulterated infant formula in China, and *Salmonella*-contaminated peanut butter leading to the imprisonment of the former CEO of Peanut Corporation of America. These events highlight vulnerabilities in the food safety chain that present opportunities and risks for investors.

To this end, the food industry is undergoing a transformation as it addresses food safety risks in an increasingly global, complex supply chain. Food safety encompasses the practices and conditions promoted across a food supply chain with the intention of ensuring food quality and preventing contamination and foodborne illness.

In this report, we examine major food safety events that have affected publicly traded US companies over the last 25 years. We identify the behavioral/demographic, regulatory, and technological factors acting as catalysts for the food industry’s transition towards increasingly proactive and innovative food safety strategies. To assess the opportunities and risks associated with this transition, we evaluate the food safety practices of nearly 60 companies throughout the food supply chain. Data is aggregated at each level of the supply chain and key findings are discussed.

We highlight three areas of food safety innovation for investors wishing to gain exposure to the food safety theme: 1) Food testing and analysis; 2) supply chain technology; and 3) automation and robotics. We present a list of 30+ companies that offer food safety solutions and rate their level of exposure. We also offer industry-level observations that may lead to additional avenues of inquiry.

Key Questions

*Which Factors Are Driving the Food Safety Conversation?*

Behavioral/demographic, regulatory, and technological forces are converging to profoundly impact how companies approach issues of food safety.

From a behavioral/demographic perspective, companies are reassessing strategies to meet shifting consumer preferences and populations. In the developed world, consumers are demanding healthier, higher-quality food products as well as more pre-packaged and ready-made options. In the developing world, rising incomes are driving demand for animal protein, which may potentially lead to more foodborne illness, especially in countries where quality control and regulatory oversight are lagging.

Globally, internet-enabled consumers are becoming increasingly aware of food safety issues. They are demanding increased transparency from companies which face reputational risk from negative publicity connected with product recalls or health incidents. Meanwhile, consumer populations that are most susceptible to foodborne illness — notably the very young and the elderly — continue to grow. This demographic trend potentially increases the magnitude of outbreaks related to foodborne illnesses.
On the regulatory front, the Food Safety Modernization Act (FSMA) which passed in 2011 and is being implemented in stages until late 2017, has fundamentally shifted the private sector mandate from that of reactive compliance (relying on production standards and government monitoring of outbreaks) to that of proactive responsibility (requiring food safety systems that actively address risks in the food supply chain). At the same time, China is undertaking significant changes in food safety regulation, focusing on problem areas such as baby formula, health foods, and online shopping. In addition, the interaction of global regulatory systems — the US, the EU, China, and other players — is set to increase, both with new trade agreements such as the Transatlantic Trade and Investment Partnership (TTIP) and with ongoing linkages of global food systems.

Meanwhile, across the supply chain, technological innovations are changing the way business is done. Cheaper, faster and more efficient computing hardware, improved software and network connectivity, and advanced sensors are among the technologies yielding new applications in food safety. Food companies are leveraging supply-chain technology powered by the Internet of Things (IoT), advanced robotics, and cheaper and more accurate gene sequencing technology. For proactive management teams, there is abundant opportunity for greater efficiency and enhanced risk management.

**What Can We Observe from Companies’ Disclosures?**

Companies employ diverse governance and management systems in order to promote food safety. In our research, we reviewed various mechanisms that may be part of a company’s governance of food safety issues. Effective corporate disclosures explain a company’s unique approach to managing these issues, and include both the overall strategy and the specific provisions used to carry out the strategy.

We assessed the food safety governance of nearly 60 companies throughout the food supply chain, aggregated our findings, and identified trends and potential risks. Our assessment revealed:

- Food safety expertise is generally present in mid-level and senior management throughout the supply chain. However, there is currently little food safety expertise present on most food company boards, as most corporate boards currently maintain oversight through risk and audit committees. We note that companies can engage external advisors and consultants as an alternative to board level expertise. The presence or absence of specific expertise on the board is less important than whether the company can articulate a compelling narrative about how the board manages food safety issues.

- Executive compensation is rarely linked to food safety goals, although companies indicated that the impact of food recalls on stock price and earnings were significant incentives for management.

- Market concentration in both food suppliers and “demanders” (i.e. commercial customers) results in the most comprehensive standards. The comprehensive voluntary standards between major poultry producers (suppliers) and major grocery stores and restaurants (demanders) support this assertion. On the other hand, fragmented value chains at both the supply and demand ends are likely to engender more limited safety standards. We observe that supply and demand for certain
products from smaller restaurant chains are fragmented (or less concentrated), potentially explaining why standards are less comprehensive.

- Restaurant companies have the lowest average disclosure rate on internal food safety systems and the use of external monitors of food safety. We note this low disclosure rate in the context of the higher impact of food safety incidents on restaurant companies identified in financial impact analysis.

- There are significant differences in disclosure amongst transportation and logistics companies. High-disclosure companies detailed safety systems, food recall protocols, supplier audits, and food safety Key Performance Indicators (KPIs). Low-disclosure companies provided little or no information relating to food safety.

**How Can Investors Gain Exposure to Companies with Food Safety Revenues?**

Given the trends discussed in this report, we identify three areas of food safety innovation that offer growth opportunities for investors:

- Food testing and analysis
- Supply chain technology
- Automation and robotics

We present a list of 30+ companies that offer food safety solutions and rate their level of exposure.

**Shareholder Engagement - What Questions Should Be Asked?**

Our research raises questions for further exploration as behavioral and demographic, regulatory, and technological factors impact food safety. Below are several pertinent questions that investors could ask their portfolio companies to gain better insight into food safety management.

- What internal systems are in place to support food safety objectives? Is third party certification required for these systems?
- What systems and certifications are required from suppliers?
- What formal food safety staff training is required? How has this training evolved over time?
- Which technologies are being used to facilitate traceability throughout the supply chain?
- Who is the lead food safety person at the company and to whom do they report? Is there a food safety committee within the firm?
- How does the board oversee food safety? Which Key Performance Indicators are reported, and how often are they provided?
Food Safety: Setting the Stage

What Is Food Safety?

Food safety encompasses the practices and conditions promoted across a food supply chain with the intention of ensuring food quality and preventing contamination and foodborne illness. Foodborne illness is caused by pathogens — including viruses, bacteria, and other microorganisms — and by toxic chemicals or other harmful substances.

Separately, food quality refers to the particular attributes of a food product — such as origin, color, texture, flavor, and nutrition — that influence the value of that product to the consumer. Food safety also differs from food security in that the latter includes issues of food safety but maintains a broader focus overall. Food security refers to a population’s physical, social, and economic access to sufficient, safe, and nutritious food in the pursuit of an active and healthy life.

Ultimately, food safety is a necessary but not sufficient condition for assuring both food security and food quality.

Using History as a Guide

Ensuring a high level of food safety has long been a priority for companies and regulators. Some critics cite the rising number of recalls as an indicator of deteriorating food safety. Our research, however, indicates that more stringent inspections and regulatory standards and improved technology are identifying food safety threats that would have otherwise gone uncheckedit. These developments are also providing data for informed policy decisions to minimize foodborne disease. The decline in food-related outbreaks and illnesses is a testament to these advances (Figures 1 & 2). Despite these improvements, food safety-related recalls represent a continued risk, and companies must continue to evolve to meet the demands required of new markets and increasingly complex supply chains.

Figure 1: US food safety related outbreaks and illnesses

Figure 2: US food safety related recalls

Source: Centers for Disease Control and Prevention, Cornerstone Capital Group
Source: Swiss Re, FDA, USDA, Cornerstone Capital Group
Food Safety’s Financial Impact

In 2011, the Grocery Manufacturers Association (GMA) in the US surveyed 36 major international companies in the food sector. Product disposal and business interruption were cited as the largest recall costs, and estimates of recall costs varied widely, with some exceeding as much as $100 million (Figure 3). While difficult to quantify, the survey also revealed that a top concern following a food safety event is damage to the brand.

Figure 3: Financial impact (sales losses, direct recall costs, etc.) of recalls on US companies

Additionally, we examined 10 major food safety events that affected publicly traded US companies over the last 25 years (Figure 4). While each food safety event is unique (and sales can be impacted by multiple factors), there are some interesting takeaways from this analysis.

Figure 4: Food safety events

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack in the Box</td>
<td>Jan. 13, 1993</td>
<td>732 people infected with E. coli originating from beef patties in hamburgers</td>
</tr>
<tr>
<td>ConAgra Foods</td>
<td>Jul. 19, 2002</td>
<td>Recalled 19M pounds of beef trim and fresh and frozen ground beef products that may have been contaminated with E. coli</td>
</tr>
<tr>
<td>Pilgrim’s Pride</td>
<td>Oct. 12, 2002</td>
<td>Recalled 27.4M pounds of fresh and frozen turkey and chicken products that may have been contaminated with Listeria</td>
</tr>
<tr>
<td>Yum! Brands</td>
<td>Dec. 6, 2006</td>
<td>71 persons infected with E. coli originating from shredded lettuce at Taco Bell</td>
</tr>
<tr>
<td>ConAgra Foods</td>
<td>Oct. 11, 2007</td>
<td>83.9M pounds of frozen pot pie products recalled due to outbreak of salmonellosis</td>
</tr>
<tr>
<td>Kroger</td>
<td>Jun. 30, 2008</td>
<td>Multistate outbreak of E. coli linked to ground beef</td>
</tr>
<tr>
<td>Campbell Soup</td>
<td>Jun. 17, 2010</td>
<td>Recalled 15M pounds of &quot;SpaghettiOs with Meatballs&quot; canned products due to possible under-processing</td>
</tr>
<tr>
<td>Tyson Foods</td>
<td>Jan. 10, 2014</td>
<td>Recalled 33,840 pounds of chicken products due to threat of Salmonella contamination</td>
</tr>
<tr>
<td>Kraft Heinz</td>
<td>Aug. 25, 2015</td>
<td>Recalled 2.1M pounds of turkey bacon products that may have spoiled before the “Best When Used By” date</td>
</tr>
<tr>
<td>Chipotle</td>
<td>Oct. 31, 2015</td>
<td>Closed 43 stores in Washington and Oregon after E. Coli outbreak was linked to its stores</td>
</tr>
</tbody>
</table>

Source: Cornerstone Capital Group
Key observations from our analysis include:

- Restaurant share prices experience the most negative and sustained impact from food safety events. In the three events we examined, same store sales (SSS), an important driver of share price, declined in the quarter in which the food safety event occurred and remained depressed for several quarters thereafter.

- While Pilgrim’s Pride and Tyson both recalled poultry products, Pilgrim’s Pride share price experienced a dramatic, albeit temporary, decline. Tyson’s share price, on the other hand, was largely unaffected. The primary differentiating factor appears to be the size of Pilgrim’s Pride’s recall, seeing as it was the largest meat recall in US history at the time.

- In the remaining cases, the food safety events had little to no observable impact on shareholder return.

**Restaurants**

Restaurant companies experienced the most sustained impact on shareholder return. A potential factor is that restaurants are downstream and more directly exposed to negative consumer perception. Unlike other downstream companies such as grocery stores, restaurants face little time between product purchase and consumption. Therefore, adulterated food may be more likely to impact human health.

We provide accounts of three major food safety events in the restaurant industry.

**Jack in the Box (JACK)**

**Figure 5: 1993 Jack in the Box E. coli outbreak**

![Graph showing total shareholder return for Jack in the Box and S&P 500 Consumer Services Industry Group Index from January 1993 to January 1994. The graph highlights the E. coli outbreak in January 1993, leading to a 20% decrease in share price, followed by a recovery.](image)

Source: Bloomberg, Cornerstone Capital Group
In January 1993, 732 people were infected with a strain of \textit{E. coli} originating from undercooked beef patties in Jack in the Box (JACK) hamburgers. The majority of victims were children; four died and 178 other victims suffered long-term health issues. The company initially refused to publicly accept responsibility, blaming its meat supplier. However, Washington State court documents revealed that JACK failed to follow state law, which required the burgers to be cooked to 155 °F (68 °C), the temperature necessary to completely kill \textit{E. coli}.\(^1\)

For the quarter in which the event occurred and the quarter following it, JACK’s same store sales (SSS) declined by 22.2% and 9.2%, respectively. JACK continued to register negative SSS for two more quarters until SSS finally turned positive four quarters after the incident. For the 12-month period following the incident, JACK’s share price underperformed its comparable index by 62%. Ultimately, in the 18 months following the outbreak, the company lost an estimated $160 million due to reduced sales and increased costs, including voluntary recalls and legal costs.

As a result of this scandal, JACK restructured its corporate operations around food safety priorities. It hired a food safety consultant who introduced the company to Hazard Analysis and Critical Control Points (HACCP), a systematic approach to food safety.\(^2\) The firm implemented frequent microbial testing on random sampling from all beef suppliers, a checklist for slaughterhouses, and strict temperature guidelines for both transportation and cooking of beef patties. It also restructured corporate incentives to prioritize food safety.

\textbf{Yum Brands (YUM)}

\textit{Figure 6: 2007 Taco Bell \textit{E. coli} outbreak}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6.png}
\caption{2007 Taco Bell \textit{E. coli} outbreak}
\label{fig:2007_taco_bell_outbreak}
\end{figure}

\textsuperscript{1} The USDA/FSIS currently recommends 160°F as the safe internal temperature for ground beef.

\textsuperscript{2} Hazard analysis and critical control points (HACCP) is a systematic preventative approach to food safety from biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe, and designs measurements to reduce these risks to a safe level.
On December 6, 2006, the Centers for Disease Control and Prevention (CDC) announced the link between an outbreak of *E. coli* and Taco Bell restaurants. The outbreak affected 71 people in the northeastern US and led to the temporary closure of 90 stores. While testing initially indicated yellow or green onions as the source of the outbreak, it was later linked to shredded lettuce.

In the quarters of the *E. coli* event and the one following it, YUM’s same store sales (SSS) declined by 5.0% and 11%, respectively. SSS then remained negative for two more quarters, and YUM’s share price underperformed its comparable index for approximately six months following the incident, until reporting better-than-expected earnings in the first quarter of 2007. We note the apparent disconnect between negative SSS and the positive earnings report. The strength was primarily attributable to growth in China, while US restaurant sales remained weak. It is also important to point out that Taco Bell is only one of three brands owned by YUM Brands (KFC and Pizza Hut are the other two).

**Chipotle (CMG)**

*Figure 7: 2015 Chipotle *E. coli* outbreak*

In the fall of 2015, media outlets began reporting *E. coli* outbreaks at various locations of Chipotle Mexican Grill (CMG). By December 21, the CDC and CMG had confirmed 177 cases across 10 states, but noted that it was unable to locate the source of the outbreak. As the stock price fell by more than 35%, the company implemented a series of measures to improve safety and regain customers. It altered cooking methods and HR policies, presented at food safety conferences, shut all stores for a full day of employee engagement (February 8, 2016), initiated the Chipotle Funding Program to help suppliers monitor quality, and offered a “free burrito” day to win back customers.

On March 8, 2016, a separate norovirus incident closed another Chipotle location in Massachusetts, renewing concerns over the company’s food safety and employee wellbeing practices.
In the quarter of the E. coli event, CMG SSS decreased 14.6%. In the following quarter (first quarter of 2016), SSS decreased 29.7%. As of mid-May 2016, CMG stock has underperformed the S&P 500 Consumer Services Industry Group Index by approximately 30% cumulatively since the outbreak occurred.

CMG’s situation is being compared to the aforementioned E. coli outbreak at Taco Bell in 2006. While the comparison is relevant, it took CMG longer to identify the source and contain the situation. CMG’s brand is also associated with “Food with Integrity,” so there is arguably more reputational risk at stake. Furthermore, social media has evolved significantly since 2006, and could complicate CMG’s efforts to reassure consumers that food safety issues have been resolved.

**Meat and Produce Companies**

**Figure 8: 2002 Pilgrim’s Pride Listeria outbreak**

![Graph showing Pilgrim’s Pride and S&P 500 Food Beverage & Tobacco Industry Group performance with key events marked: Recall, Oct 30, reported 65% decline in FY2002 profit partly because of the outbreak; however, the company also expected FY2003 to rise 43%; Nov 13, reopened poultry processing plant; Jun 9, announced acquisition of chicken sales by ConAgra for $590M.]

Source: Bloomberg, Cornerstone Capital Group

In October 2002, Pilgrim’s Pride Corporation (PPC) voluntarily recalled 27.4 million pounds of turkey and chicken products, citing possible Listeria contamination — at the time, the largest meat recall in US history. In reaction, PPC lost a quarter of its market cap in a single day. This recall followed a separate avian influenza outbreak which forced the company to destroy $4.7 million worth of turkeys. During these events, PPC consistently claimed that it had control over the situation.

Despite the costly recall and public relations hit, the share price started to recover in late October when the company released an optimistic outlook that included a 43% expected rise in annual profit in FY2003. Over the next year, PPC stock continued to outperform its respective Food Beverage and Tobacco Industry Group Index benchmark. One year after the incident, the stock had outperformed by nearly 100%, in part due to a well-received acquisition announcement in June 2003.

This event stands in contrast to the smaller recall of 33,000 pounds of chicken products by Tyson Foods in January 2014 due to Salmonella. The recalled products were produced in October 2013 for institutional (i.e. prisons) use only and were not for sale through
retail stores. Seven people were identified as having been sickened by the products between November and December 2013.

**Figure 9: 2014 Tyson Foods *Salmonella* outbreak**

Other Events

Our analysis reveals that other food safety events (ConAgra in 2002 and 2007, and Kroger, Campbell Soup, and Kraft Heinz) did not negatively impact the companies' share price. Because these are large companies with diversified product portfolios, the financial losses associated with the recalls (sales losses, direct costs of recall, etc.) appear to be minor in scope relative to the overall business.

The absence of an acute share price reaction does not suggest food safety can be overlooked at these companies. The diversified product portfolio mutes the immediate impact of an incident, though it may not insulate the company from potentially longer-term brand damage.
Which Factors Are Driving the Food Safety Conversation?

Behavioral and Demographic Shifts

We identify five emerging trends that present opportunities and challenges for food safety.

1. **There is a growing preference for organic, antibiotic- and preservative-free, and locally sourced food in the developed world** (Figures 9 and 10). As these products capture market share, they require the food supply chain to adapt. For instance, Cargill says that it has been asked by some customers to remove additives that it puts in processed meat to inhibit *Listeria* growth.³

   In another example, demand for raw/unpasteurized milk has grown as states have legalized its sale and distribution. According to the CDC, this trend coincides with an increasing number of reported raw-dairy-related outbreaks, as raw milk and raw milk products are 150 times more likely to cause health issues than their pasteurized counterparts (Figure 11).⁴

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**Figure 9: Consumers prefer food that gives them peace of mind**

<table>
<thead>
<tr>
<th></th>
<th>Significantly more (5% increase or more)</th>
<th>Slightly more (up to a 5% increase)</th>
<th>No more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservative-free</td>
<td>11%</td>
<td>26%</td>
<td>39%</td>
</tr>
<tr>
<td>Hormone-free</td>
<td>10%</td>
<td>27%</td>
<td>38%</td>
</tr>
<tr>
<td>Antibiotic-free</td>
<td>9%</td>
<td>27%</td>
<td>38%</td>
</tr>
<tr>
<td>Having no artificial sweeteners</td>
<td>8%</td>
<td>21%</td>
<td>44%</td>
</tr>
<tr>
<td>GMO-free</td>
<td>10%</td>
<td>24%</td>
<td>36%</td>
</tr>
<tr>
<td>Natural</td>
<td>9%</td>
<td>20%</td>
<td>38%</td>
</tr>
<tr>
<td>Unprocessed</td>
<td>7%</td>
<td>22%</td>
<td>36%</td>
</tr>
<tr>
<td>Clean</td>
<td>10%</td>
<td>19%</td>
<td>33%</td>
</tr>
<tr>
<td>Real</td>
<td>5%</td>
<td>17%</td>
<td>39%</td>
</tr>
<tr>
<td>Organic</td>
<td>10%</td>
<td>21%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Numbers to the right of each bar represent the percentage of consumers surveyed who said they would be more likely to purchase food or beverages described by the term on the vertical axis (e.g. preservative-free). The colors of the bar reflect how much more, if at all, those consumers are willing to pay.

Source: Technomic 2014, Cornerstone Capital Group

**Figure 10: US organic food sales on the rise**

- **Fruit and vegetables**
- **Dairy**
- **Beverages**
- **Packaged/prepared foods**
- **Breads and grains**
- **Snack foods**
- **Meat, fish, poultry**
- **Condiments**


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Organic, antibiotic- and preservative-free, and locally sourced products do not inherently entail increased food safety risks. However, companies are adapting to new and evolving supply chains, and consumers and governments expect accountability and high standards of food safety throughout the transition.

2. The shift toward two-earner families and busier lifestyles in developed markets and some developing markets means that fewer meals are being cooked at home. Spending on pre-packaged and ready-to-eat foodstuffs is notably increasing. However, this category of food is most affected by recalls (Figures 12 and 13). Ready-to-eat meals require complex production processes with numerous ingredients from various suppliers coming together on a “just in time” basis. Consumers are also allocating a larger share of their food budget to “eating out” instead of at home (Figure 14).

Figure 11: US documented outbreaks associated with unpasteurized milk, 1998-2014

![Graph showing US documented outbreaks associated with unpasteurized milk, 1998-2014](image)

Source: Centers for Disease Control and Prevention

Figure 12: Consumer survey: "Why do you purchase ready meals versus preparing a meal from scratch?"

<table>
<thead>
<tr>
<th>Reason</th>
<th>Share of respondents selecting</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not have time to cook</td>
<td>45%</td>
</tr>
<tr>
<td>Ready meals are affordable</td>
<td>31%</td>
</tr>
<tr>
<td>I do not cook very well</td>
<td>21%</td>
</tr>
<tr>
<td>Ready meals are tastier than the food I cook</td>
<td>16%</td>
</tr>
<tr>
<td>I do not like to cook</td>
<td>14%</td>
</tr>
<tr>
<td>I live alone and I do not want to cook for one person</td>
<td>13%</td>
</tr>
<tr>
<td>I do not know how to cook</td>
<td>11%</td>
</tr>
<tr>
<td>Ready meals are healthier</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Euromonitor International 2012, Cornerstone Capital Group

Figure 13: Ready-to-eat meals are most affected by recalls in the US

- Ready-to-eat food 21%
- Fruits, vegetables & nuts 8%
- Food supplements & functional food 8%
- Meat & poultry products 9%
- Sugar & confectionery products 15%
- Grain mill & bakery products 12%
- Milk & dairy products 14%
- Fish & seafood 9%
- Others 10%

Source: Swiss Re 2015, Cornerstone Capital Group

In light of these trends, packaged food producers and restaurants are enjoying an expanding market. But with growth comes risk, and companies that do not adequately address food safety may exacerbate an existing consumer trust issue. According to a 2015 Science and Food Survey conducted by the Chicago Council on Global Affairs, a stark contrast exists between how the public thinks food producers are performing on food safety, and how they think they should perform (Figure 15). This “perception gap” exists across numerous issues, but food safety is where the respondents were most dissatisfied.6

3. **Consumers are becoming increasingly aware of food safety issues, and are demanding increased transparency from companies.** In both developed and developing markets, a number of high-profile food safety incidents have led to heightened consumer awareness. The proliferation of mobile devices and social media is accelerating this trend. Information travels more quickly, thereby diminishing the ability of companies to control the message that comes out of a food safety incident.

4. **Rising incomes in developing markets will drive growth in demand for animal protein and dairy (Figure 16).** These products are resource-intensive and will put additional pressure on local supply chains. One implication is that bacteria found in animals may potentially cause more foodborne illness, especially in countries where quality control and monitoring programs are scantily developed. Moreover, increasing global demand for animal protein has led to the rise of certain farming practices, such as aquaculture in some lesser developed/less-regulated markets, which may more easily allow the transmission of foodborne parasites.7

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5. **As populations in developed markets continue to age, more people will be at risk for foodborne diseases.** Due to their weaker immune systems, infants and older adults are particularly vulnerable to illnesses, including those caused by foodborne pathogens. Examination of CDC FoodNet data shows that for many pathogens, incident rates and/or the probability of severe outcomes tend to increase with age (Figures 17 and 18).

**Figure 16: Rising global meat and milk consumption**

![Graph showing rising global meat and milk consumption](image)

*Source: World Health Organization, Food and Agriculture Organization of the United Nations, Cornerstone Capital Group*

**Figure 17: Incidence of select infections per 100,000 people by age in the US, 2014**

![Graph showing incidence of select infections](image)

*Source: 2014 FoodNet Annual Report by Centers for Disease Control and Prevention, Cornerstone Capital Group*

**Figure 18: Shares of people hospitalized for select infections by age in the US, 2012**

![Graph showing shares of people hospitalized](image)

*Source: 2012 FoodNet Annual Report by Centers for Disease Control and Prevention, Cornerstone Capital Group*
Regulatory Developments

Regulation is a significant driver of food safety advances, and new food safety regulations have been implemented in both developed and developing countries. In the US, food safety regulation began in the early 1900s and grew rapidly in the latter half of the 20th century with a range of regulations regarding inspections, product composition, and product safety. The most recent significant regulatory change in the US was the introduction of the Food Safety Modernization Act (FSMA) in 2011.

Figure 19: US food safety regulatory timeline

Food Safety Modernization Act

FSMA changes how food safety is regulated in US, mandating that food safety systems actively address risks in the food supply chain rather than rely on production standards and government monitoring of outbreaks and incidents. The introduction of FSMA in 2011 mandated a change in approach to food safety from the FDA and associated agencies as well as implementation of new food safety rules for key elements of the food supply chain.

In addition, there are six new rules enforceable by the US Food and Drug Administration (FDA) and the US Department of Agriculture (USDA) that relate to food production, animal feed, produce packaging, food imports, transportation, and food adulteration. General compliance with these rules is required starting between September 2016 and October 2017, depending on the rule⁸.

The majority of FSMA changes and new rules require operational changes by companies, but we view the FDA’s increased ability to mandate product recalls and suspend production as a key change. Previously, companies voluntarily recalled products that were identified as posing risks to human health. The FDA can now force companies to recall products, potentially changing how companies must react to food safety issues and altering the reputational risk landscape.

The FDA has also expanded its scope for holding and testing food prior to release to market. Prior to FSMA, companies maintained food safety systems with the priority of ensuring “reasonable certainty of no harm” and using ingredients that are “generally recognized as safe.” The FDA then only held products that presented “credible evidence” of “threat of serious adverse health consequences or death”. Now, the FDA can hold and test any foods that it has reason to believe are adulterated or misbranded.

While general compliance with the new rules is proposed to start later this year, the impact of the new approach of the FDA on food safety mandated by FSMA has coincided with a significant uptick in recalls. The USDA, responsible for the safety of meat, poultry, and egg products, works alongside the FDA. Data on USDA recalls is shown in Figure 21.
Over the last 10 years, the USDA has increased detention of food it believes to contain undeclared allergens or for which it found insufficient information to make a reasonable assessment. The growth in number of USDA recalls could imply a higher number of recall events from the FDA going forward, presenting greater reputational and operating cost risks to companies.

**Globalization of Food Supply Chain**

Global trade volume in food and agricultural products reached close to $1.8 trillion in 2014, making it the third-largest major product category after fuels and chemicals. This trade facilitates the creation of cuisine that has components from around the world. For example, even a hamburger may have components originating from more than 10 countries (Figures 22 and 23).

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*Note: “Other” includes producing without inspection, or failure of importers to present products for import inspection. It is also known as “Failure to Present (FTP)”*

*Shiga toxin-producing *E. coli*

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[9](https://www.wto.org/english/res_e/statis_e/its2015_e/its15_merch_trade_product_e.pdf)
US food imports have grown over the last two decades with plant, raw, and processed food experiencing the highest growth rates (Figures 24 and 25).

As food imports grow, so does the interconnectedness of food safety regulatory systems. Similar systems enable reduced trade barriers and processing time, while major differences in systems can slow trade and increase the risk of food safety incidents.

FSMA aligns the US more broadly with the risk assessment and prevention approach to food safety taken by the EU. At the same time, China is undertaking significant changes in its food safety regulation, focusing on problem areas such as baby formula, health foods and online shopping. The interaction of these regulatory systems is set to increase with new trade agreements, such as the Transatlantic Trade and Investment Partnership (TTIP), and with ongoing linkages of global food systems.

An assessment of two countries’ and one region’s food safety systems and new trade agreements is shown in Appendix 1. The assessment shows that food safety approaches are converging in the EU and US, with China quickly implementing new processes and
regulations to address food safety issues. However, the US has fewer restrictions and labeling requirements relating to the use of livestock antibiotics, growth hormones, poultry antimicrobial rinse, and genetically modified foods than the EU, while China is increasing its scrutiny on these inputs. Multi-party trade agreements aim to increase food trade, particularly between the US and Europe, but China is not participating in either the TTIP or the Trans-Pacific Partnership (TPP).

**Technological Innovation**

Across the supply chain, technological innovations are changing the way business is conducted. Cheaper, faster, and more efficient computing hardware, improved software and network connectivity, and advanced sensors are among the technologies that are yielding new applications in food safety. Technological innovations are also converging to accelerate the utilization of advanced supply chain technology, automation, and genomic sequencing.10

**Supply Chain Technology**

As the food supply chain becomes increasingly global and regulations require more detailed monitoring and record-keeping, food companies are leveraging supply-chain technology powered by the Internet of Things (IoT) to address food safety challenges.

Simply defined, the IoT refers to the network of physical objects embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.11 When existing infrastructure is connected, there are opportunities to integrate the physical world with computer-based systems. As a result, an IoT-empowered food safety system allows automated data collection and analysis, continuous monitoring, remote real-time accessibility, and digital record-keeping.12

Advanced sensors are one of the technologies enabling the IoT in food safety. Sensor costs are declining as mobile device demand (i.e., smartphones and tablets) drives production efficiencies and economies of scale. These devices are a prominent source of big data and are used in data collection, monitoring, decision-making, and optimization. With regards to food safety, sensors monitor key production conditions such as temperature, shipping time, and signs of disease in livestock.

Radio frequency identification (RFID) technology also offers promise for food safety. RFID tags, which typically consist of a microchip attached to an antenna, use radio waves for identification and tracking purposes. This provides an advantage over barcodes, which require an unobstructed line-of-sight between the barcode and reader. RFIDs are still more expensive than barcodes, but decreasing costs, improving performance and reliability, and increasing standardization are driving RFID usage not only in food safety, but in supply-chain management broadly as well.

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10 Please see Cornerstone Capital Group’s report on “The Economics of Automation: Quick Service Restaurant Industry,” for detailed analysis.
12 powerhouse Dynamics, “Better & Faster: The Internet of Things Reinvents Food Safety Management for Food Service Operators”
When combined with sensors, RFID technology can provide a comprehensive solution for identifying products, enhancing traceability, and responding to problems in real-time (or close to real-time).

**Figure 26: Price development of RFID tags**

![Graph showing price development of RFID tags over time](image)

*Source: State of the art report *Options for sustainable food processing* by European Parliament 2013*

**Advanced Robotics**

Robots originally emerged downstream in the food production process, where they were used primarily in palletizing (stacking cases of product) and packaging. Since then, robotics has penetrated upstream into areas such as production and picking. We believe this trend is set to accelerate. Companies are addressing rising labor costs, employee health issues resulting from repetitive motions, and costly food safety and hygiene compliance. At the same time, robot performance is improving while previously constraining factors such as cost, weight, and assembly hours are declining.

**Figure 27: Tasks for which robots are used in the food and beverage industry**

<table>
<thead>
<tr>
<th>Task</th>
<th>Number of Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>12</td>
</tr>
<tr>
<td>Repackaging</td>
<td>11</td>
</tr>
<tr>
<td>Palletizing</td>
<td>27</td>
</tr>
<tr>
<td>Picking</td>
<td>5</td>
</tr>
<tr>
<td>Production</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: DGL, Buckenhuskes and Oppenhauser, 2014*

**Figure 28: Evolution of robotics**

![Graph showing evolution of robotics over time](image)

*Source: KUKA, Cornerstone Capital Group*
Robots offer several advantages in managing food safety. For example, robots can work in harsh environments, such as the extremely cold temperatures required for frozen foodstuffs, without compromising speed or reliability.

Robots also minimize human workers’ contact with food products. This is important considering infected food workers cause about 70% of norovirus outbreaks, which, according to the CDC, is the leading cause of disease outbreak from contaminated food.

Finally, robots can offer embedded traceability. Robotic vision systems read barcodes and store information, and robots can be interfaced to other product ID technologies such as RFID tags. This functionality also allows robots to be integrated into the IoT, thereby becoming part of an advanced supply-chain solution.

Along with food safety benefits offered by robots, improvements in product consistency, worker safety, and productivity are all driving robot order growth in the food and beverage industry. According to data from the Robotic Industries Association, food and consumer goods increased its share of North American robot orders from 3% in 2005 to 7% in 2014 (Figure 29). Moreover, the latest generation of robots — small, lightweight, flexible, and connected robots — offer advantages that make them an interesting option for tasks that have not previously been automated.

In a recent example of robot deployment, Nestlé announced that it will install a fully automated storage and material handling system at one of its production sites for baby and infant food. The installation will include an integrated warehouse shuttle system with connecting conveyor system technology, as well as several automated guided

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vehicles. Nestlé’s decision to launch the project, targeted for January 2017, was based, among other factors, on the need to comply with sensitive food production guidelines.14

**Genomic Technology**

Whole genome sequencing (WGS) has emerged as the most comprehensive method for analyzing the genome. Although commonly associated with sequencing human genomes, the scalable and flexible nature of WGS technology makes it equally useful for sequencing any species, including livestock, plants, and/or disease-related microbes.15 The cost of gene sequencing technology has declined precipitously (Figure 30), opening the door to new applications within food safety. To illustrate the nature of the reductions in DNA sequencing costs, the graph also shows hypothetical data reflecting Moore’s Law, which describes a long-term trend in the computer hardware industry that involves the doubling of ‘compute power’ every two years. Technology improvements that 'keep up' with Moore's Law are widely regarded to be doing exceedingly well, making it useful for comparison.

**Figure 30: Cost of sequencing a human-sized genome, 2001-2015**

![Graph showing the cost of sequencing a human-sized genome, 2001-2015](source: NHGRI Genome Sequencing Program 2016, Cornerstone Capital Group)

The most basic food safety application of genomic sequencing is to identify pathogens during foodborne illness outbreaks. Pathogens isolated from food or environmental samples are compared to isolates from sick patients. A match helps define the scope and origin(s) of the foodborne illness.

A major advantage of WGS over traditional technology — for instance, pulsed-field gel electrophoresis (PGFE) — is the level of detail and accuracy provided. PGFE cannot differentiate between certain strains of pathogens nor distinguish between samples associated with previous outbreaks. WGS technology does not have these limitations.

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thereby allowing scientists to determine if two people infected with the same strain of pathogen were affected by the same food source.  

While WGS is building upon existing methods for pathogen testing, it is also creating a new market for studying the microbial ecology of foods and their processing environments throughout the food supply chain. From a regulatory standpoint, the FDA and other public health agencies can use WGS during routine inspections to monitor compliance with FSMA. The FDA is also spearheading an international effort to sequence the genomes of foodborne pathogens and to upload this data, along with the geographic location from which a given pathogen was gathered, into a public database called GenomeTrakr (Figure 31).

**Figure 31: Total number of sequences in the GenomeTrakr Database, 2013-2016**

Equally important, companies throughout the food supply chain are leveraging next generation genomic technology to mitigate foodborne illness risk. For instance, the Consortium for Sequencing the Food Supply Chain, run by IBM Research and Mars, Inc., is building infrastructure to collect, aggregate, and analyze pathogen data in order to deliver insight into microbial management.

**Bringing It Together: Food Safety Is in a State of Transformation**

Ensuring a high level of food safety has long been a priority for companies and regulators. There have been significant developments in food safety as the field has become considerably more evidence-based, quantitative, and reliant on risk management.

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http://www.fda.gov/Food/FoodScienceResearch/WholeGenomeSequencingProgramWGS/
Much of the progress made in food safety, however, has been crisis-driven and reactionary in nature — a strategy that may now be outdated.

**Figure 32: Converging forces impacting food safety**

The regulatory environment is shifting to one focused on prevention, and consumers are becoming more engaged in the source, production and quality of the food they eat. Rising protein demand in developing markets is shifting supply-chain risks and making them more complex, and aging populations present more serious implications for companies faced with food safety incidents.

Furthermore, the proliferation of internet-connected mobile devices and social media is accelerating the rate at which information travels. This is leading not only to increased transparency, but also to a diminished ability of companies to control the message around a food safety incident.

From a solutions perspective, the food industry can leverage IoT-empowered supply chain technology, advanced robotics, and next generation genomic sequencing equipment to enact meaningful and positive change. In addition to addressing food safety challenges, this dynamic/environment presents clear growth opportunities for companies that offer solutions within these areas.

Our research indicates that technological, regulatory, and behavioral/demographic factors will catalyze the food industry’s transition towards increasingly proactive and innovative food safety strategies.
Food Safety Disclosure Assessment

To consider the opportunities and risks associated with a transition in food safety practices, we assessed the food safety practices of almost 60 of the largest, U.S.-based companies throughout the food supply chain in the following segments:

- Meat and produce
- Diversified and snack foods
- Transportation and distribution
- Grocery stores
- Restaurants
- Agricultural products

Supplementing information disclosed in company filings (annual report, earnings transcripts, sustainability report, website, etc.) with interviews with investor relations, sustainability, and food safety officers, we reviewed each company with respect to the following food safety elements:

1. **Internal food safety system** – Public disclosure of a company-wide food safety system may suggest that the company is confident that it can withstand public scrutiny. It may also be a source of competitive advantage. Internal safety systems include Hazard Analysis and Critical Control Points (HACCP) and Good Manufacturing Practices (GMP), as well as independent systems.

2. **Externally certified** – Additional, voluntary third-party accreditation, particularly those recognized by the Global Food Safety Initiative (GFSI), indicates transparency and willingness to allow external review of a company's food safety system.

3. **Supplier management system** – A publicly available food safety code of conduct for suppliers shows a company's recognition that food safety issues manifest in other segments of the supply chain and affect the company's customers.

4. **Food safety committee and staff training** – Disclosure of company-wide food safety committee and ongoing staff training indicates a commitment to food safety issues.

5. **Published food safety key performance indicators** – Reporting of food safety incidents, recalls and plant/store audits in public filings creates accountability and enables stakeholders to track progress.

6. **Food safety risks in 10-K reports** – Explicit acknowledgement of food safety risks in the 10K indicates food safety issue awareness at the board and executive levels.

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17 The Hazard Analysis and Critical Control Points (HACCP) system, which is science-based and systematic, identifies specific hazards and measures for their control to ensure food safety. HACCP can be applied throughout the food chain from primary production to final consumption and its implementation should be guided by scientific evidence of risks to human health.

18 A Good Manufacturing Practice (GMP) is a system for ensuring that products are consistently produced and controlled according to quality standards. It is designed to minimize or eliminate instances of contamination, mix-ups, and errors.

19 The Global Food Safety Initiative (GFSI) is an industry-driven initiative providing thought leadership and guidance on food safety management systems necessary for safety along the supply chain. Certification to a GFSI recognized scheme is achieved through a successful third party audit against any of the schemes that have been recognized by the GFSI.
7. **Product traceability** – Discussion of traceability initiatives beyond "one-up, one-down" (i.e. ability to trace products one step backwards and one step forwards in supply chain).

8. **Executive compensation** – Linking executive and board compensation to food safety metrics provides explicit incentives for addressing food safety at a company's highest levels.

9. **Lead safety person** – The existence of senior, qualified food safety personnel (e.g. a Chief Food Safety Officer) with a direct link to the executive suite indicates strong commitment to managing food safety.

10. **Food safety expertise on board** – Food safety expertise on the corporate board enables further scrutiny and board input into food safety approach.

11. **Sick leave policy** – The CDC notes that in a study of workers in 426 restaurants, 12% had worked when sick with vomiting or diarrhea. Comments from workers were that they would not have worked if they had a sick leave policy. The existence of a sick leave policy signals that food safety risks are being mitigated at all levels of the company.

In the following sections, we aggregate data and present key observations at each level of the supply chain. We note that companies agreed to provide additional information on the basis that we would not explicitly compare or rank food safety approaches within a particular segment. Therefore, we do not disclose company-specific information except where we view it as best practice.

Furthermore, the food supply chain and food safety is global in nature and there are implications for non-US investors and companies. However, to ensure data comparability and an assessment scope that enables us to generate actionable insights, we focus on the US food industry, while including some key non-US companies with major US presence in the food chain as well.

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Meat and Produce

Figure 33: Results for meat and produce

<table>
<thead>
<tr>
<th>Category</th>
<th>Disclosed</th>
<th>Not Disclosed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety System</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Externally Certified</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Supplier Management System</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Published KPIs</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Food Safety Risk in most recent 10k</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>Full Traceability</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>Executive Compensation</td>
<td>11%</td>
<td>89%</td>
</tr>
<tr>
<td>Explicit Food Safety Expertise on Board</td>
<td>22%</td>
<td>78%</td>
</tr>
</tbody>
</table>

Source: Company documents and interviews, Cornerstone Capital Group
Sample size: 9 companies

Meat and produce companies show a high degree of disclosure on internal safety systems (HACCP and GMP) and external certifiers, reflecting ongoing consumer and regulatory focus on safe meat and produce. Many publish KPIs and note food safety risks in financial filings.

However, there are fewer disclosures relating to supplier management or executive compensation. Only two boards that were studied have a member with explicit food safety expertise, and only one company explicitly links executive compensation to food safety.

Notable initiatives include:

- Hormel Foods and Maple Leaf Farms have implemented pork product traceability back to the individual hog, while Marine Harvest has developed genotyping tools to quickly identify sources of Listeria outbreaks.
- Dean Foods includes a recall target in the performance pay for the CEO.
- Maine Harvest publishes the most food safety related KPIs including food safety incidents, customer claims, and total recalls.
- Hormel Foods and Marine Harvest each have two food safety experts on their board of directors.
Diversified and Snack Foods

Figure 34: Results for diversified and snack foods

Source: Company documents and reports, Cornerstone Capital Group
Sample size: 15 companies

Diversified and snack foods are subject to intense consumer and regulatory pressure which, in part, supports the high disclosure rate on internal safety systems, external certifiers, and supplier management. Food safety risks are also noted clearly in annual filings.

Similar to meat and produce companies, there is little disclosure on compensation linked to food safety goals. There is no disclosed food safety expertise on the boards of the assessed companies.

Notable initiatives include:

- BRF S.A., ConAgra, and Kellogg Co. disclose food safety KPIs which include supplier products under third-party certification, product recalls, and food safety audits.
- Traceability beyond regulatory requirements generally focuses on sustainability assurance for palm oil. We view this as an environmental disclosure rather than a food safety issue.
- Kellogg’s uses performance-based cash bonuses to promote achieving business goals that explicitly include food safety.
Transportation and Distribution

Figure 35: Results for transportation and distribution

Source: Company documents and interviews, Cornerstone Capital Group
Sample size: 5 companies
Note: One company recently conducted an initial public offering (IPO) and food safety risks were mentioned as a risk in the IPO filings.

We observe a high degree of variation in food safety disclosure among transportation and distribution companies examined. All of the companies note food safety as a risk in financial filings.

However, only three of the five provide information on internal safety systems, supplier management systems, and traceability programs. None of the companies disclose food safety KPIs or compensation aligned with food safety goals.

Notable initiatives include:

- Sysco has implemented an audit system for its ready-to-eat produce customers, and audits Sysco brand products annually. In addition, Sysco has a dedicated approval system for ground beef, veal, and specialty meats. The company has a GS1 Standards Initiative that enables the tracing back to all raw materials. GS1 is an international not-for-profit organization that develops and maintains standards for supply and demand chains across multiple sectors. GS1 standards provide a common foundation for companies to identify, capture, and share supply chain data. Bar codes and RFID technology are key in capturing data in this process.

- Performance Food Group designates “recall leaders” at each location to ensure recall effectiveness. It also has a trace back system for all of its Braveheart branded beef products.
Grocery Stores

Figure 36: Results for grocery stores

Source: Company documents and interviews, Cornerstone Capital Group
Sample Size: 8 companies

Grocery stores disclose information about their supplier management systems at a rate equal to other parts of the value chain, and food safety is commonly reported as a risk to investors in 10-K reports.

However, only half of those studied disclose information on internal safety systems and external certifiers. Food safety KPIs and traceability are also discussed infrequently. None of the firms disclose any link of executive compensation to food safety or any food safety expertise on the boards.

Notable initiatives include:

- Wal-Mart has mandated GFSI and Safe Quality Food (SQF) for all suppliers and uses meat traceability systems.
- Costco manages suppliers and factory audits through its Traqtion system. Through its membership database, Costco can contact every customer who has purchased a recalled product.
- Delhaize Group reports progress against 2020 targets on supplier food safety compliance, factory audits, and product recalls.
Restaurants

A majority of restaurants in our sample provide detail on supplier management systems and note food safety as a risk in 10-Ks. However, restaurants rarely disclose information regarding internal safety systems and external certifiers. KPIs are also published infrequently. Only one restaurant links executive compensation to food safety or has a board member with disclosed food safety expertise.

Notable initiatives include:

- Starbucks has implemented a product traceability program that enables the company to trace 100% of the raw materials in a particular product within four hours. Similarly, Darden Restaurants has implemented full product traceability for shelf life management and food safety crisis management with leading supply chain standards organization, GS1.
- Panera, Texas Roadhouse, Cheesecake Factory, and Jack in the Box have implemented HACCP and GMP plans for food preparation.
- Chipotle, McDonald’s, and Cheesecake Factory disclose the presence of a sick leave policy, though the level of detail varies.

Source: Company documents and interviews, Cornerstone Capital Group
Sample size: 14 companies
Agricultural Products

Agricultural product companies operate upstream, supplying products and services to food producers. The category encompasses a diverse group of companies that operate in markets such as:

- Fertilizers
- Seeds, herbicides, and other agricultural chemicals
- Animal feed and feed products
- Agricultural commodity processing (i.e. vegetable oil, flour, grains)

Due to the segment’s diverse mix of companies and unique set of issues, many of the food safety elements we use to consider other parts of the supply chain are not applicable. Furthermore, the impact of these products on the safety of the end product is diffuse. The goal of product safety and quality is primarily focused on supporting the food safety processes of their customers.

For example, antibiotic use in livestock and poultry production is a commonly cited food safety issue. The proliferation of antibiotic resistance is primarily attributed to the misuse and overuse of the drugs in animal agriculture and human medicine. Animal health companies that manufacture products such as anti-infectives, medicated feed additives, and vaccines are addressing regulations and consumer scrutiny that may curb antibiotic usage in livestock and poultry production. 21

Other food safety trends impact agricultural product companies to a lesser extent. Companies that produce fertilizers such as potash, nitrogen, and phosphate must ensure product quality and proper labeling, but the risks around foodborne illness originating from their products is minimal. Using sewage sludge as fertilizer on food crops is a separate food safety issue and is not part of the product portfolio for large, publicly traded fertilizer companies such as Agrium and PotashCorp.

Considering the diverse mix of companies, distinct sets of issues, and diffuse impact on the end products, we did not apply our assessment framework to agricultural products.

21 Please see Cornerstone Capital Group’s report on “Antibiotics and Animal Health: Value-Chain Implications in the US,” for detailed analysis.
Observations for the Food Supply Chain

Restaurants

Restaurants have the lowest average disclosure rate for internal food safety systems and external certification. Comments from interviewee companies pointed to the absence of an industry-wide standard and the fragmented county and city health inspector system as contributing factors.

The lack of disclosed safety systems contrasts with the outsized contribution of restaurants (full service and quick service) to food safety outbreaks. Figures 38 and 39 show that the 20% of calories consumed in restaurants and fast food outlets account for 40% of food safety outbreaks. Given the increasing tendency for Americans to eat out rather than prepare their meals at home (Figure 14), it is unlikely this trend will change any time soon.

Considering this relationship, it is possible that additional regulation may emerge to standardize food safety in restaurants. Furthermore, investors can use safety system disclosure and food safety KPI reporting by fast food companies as a proxy for managing food safety risk.

Transportation Divergence

The limited sample of publicly traded transportation and logistics companies reveals significant differences in disclosure. High-disclosure companies detailed safety systems, food recall protocols, supplier audits, and food safety KPIs. Low-disclosure companies provided little or no information relating to food safety.

FSMA includes new rules for the food transportation and distribution system, particularly the refrigerated food chain. With growing regulatory scrutiny, investors could consider disclosures as a proxy for the management of food safety issues.
**Upstream vs. Downstream**

Our food safety assessment shows lower levels of disclosure moving from upstream to downstream. To this end, a Duke University report titled “A Global Value Chain Approach to Food Safety and Quality Standards” provides an analytical framework for considering differences in standards and, by association, disclosure.\(^{22}\)

The analytical framework, shown in Figure 40, suggests that there is a relationship between the relative concentrations of food suppliers and “demanders” (i.e., commercial customers), and the prevalence of standards. Market concentration in both food suppliers and “demanders” (bilateral oligopolies) results in the most comprehensive standards. The comprehensive voluntary standards between major poultry producers and major grocery stores, including the development of the GFSI, supports this idea.

On the other hand, fragmented value chains at both the supply and demand ends are likely to encounter more limited public standards. We observe that supply and demand for certain products in the restaurant industry are fragmented (or less concentrated), potentially explaining why private standards are less comprehensive than in some areas of the supply chain.

**Figure 40: Value chain governance and food standards**

<table>
<thead>
<tr>
<th>Food demand (retail/buyer)</th>
<th>Concentrated</th>
<th>Fragmented</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bilateral oligopolies</strong></td>
<td>Private</td>
<td>Producer-driven chains</td>
</tr>
<tr>
<td></td>
<td>Most comprehensive standards</td>
<td>Public + private Safety &amp; quality-focused process standards</td>
</tr>
<tr>
<td><strong>Buyer-driven chains</strong></td>
<td>Public + private Safety &amp; quality-focused product standards</td>
<td>Traditional Markets</td>
</tr>
<tr>
<td></td>
<td>Limited public standards Least comprehensive standards</td>
<td></td>
</tr>
</tbody>
</table>

Source: Gereffi and Lee (2009), Cornerstone Capital Group

While the concentration of buyers and sellers is not the sole explanatory variable for the differences in standards, investors can use relative concentration to determine the likely implementation of food safety standards in different segments of the food value chain.

**Board Expertise**

A 2013 survey of risks in the Food Processing and Distribution industry found that, within food processing and distribution, damage to reputation/brand and product recall ranked second and third, respectively, behind only commodity prices.\(^{23}\) 74% of companies reported a formal review of readiness for managing product recall risks.

We examined whether a company had explicit food safety expertise, defined by having food safety education or previous experience in food safety/quality roles on the Board of

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Directors. This criterion was narrow as we aimed to assess how board-level governance related to the industry's view that food safety issues are a top priority.

Our assessment revealed that food safety expertise is generally present in mid-level and senior management throughout the supply chain. However, most corporate boards currently maintain oversight through risk and audit committees; there is little food safety expertise present on most food company boards.

We note that, as an alternative to board level expertise, companies can engage external advisors and consultants. The presence or absence of specific expertise on the board is less important than whether the company can articulate a compelling narrative about how the board manages food safety issues.

**Executive Compensation**

Executive compensation is rarely linked to food safety goals, although companies indicated that the impact of food recalls on stock price and earnings were significant incentives for management.
Potential Growth Opportunities

Given the trends discussed in this report, we identify three areas of food safety innovation that offer growth opportunities for investors:

- Food testing and analysis
- Supply chain technology
- Automation and robotics

Food Testing and Analysis

The food testing market — estimated to be a $2 billion global market — is expanding due to the enactment of government regulations such as FSMA, quality improvement initiatives by food processors, and consumer demand for safer food.

The market is divided into three segments including testing for pathogens, indicator organisms, and chemical contaminants. Pathogen testing accounts for the greatest share of the food safety market, and three organisms — Salmonella, Listeria, and E. coli O157 — account for 98% of volumes. Approximately two-thirds of pathogen testing volume occurs at food processing companies and one-third at third-party contract testing labs.

There are three pathogen testing methods commonly used: culture, immunochemical, and molecular. Tradeoffs exist between accuracy, time to results, and complexity/labor intensity of pathogen testing workflows. Currently, culture and immunochemical represent about 61% of testing volume in North America, but molecular is poised to grow due to better accuracy and faster time to results.

Key companies operating in the molecular space include DuPont, Bio-Rad, and Roka Bioscience. Neogen and bioMerieux have competitive offerings in immunochemical and culture testing. Neogen also has a partnership with Illumina, the market leader in genetic sequencing machines, where Neogen’s custom SNP content (genomic data) is built on...
Illumina’s technology and sold to agrigenomics customers. Testing, inspecting, and certification (TIC) companies are also benefiting from the trends in food safety through their global network of food testing labs. These labs establish the safety, composition, authenticity, origin, traceability, and purity of food. Eurofins Scientific has the strongest focus on food testing of the major TIC companies.

Supply Chain Technology

As the food supply chain becomes increasingly global and regulations require more detailed monitoring and record-keeping, food companies are leveraging supply-chain technology powered by the Internet of Things (IoT) to address food safety challenges.

PAR Technology’s SureCheck software is an HACCP solution that replaces manual paper-based methods with an IoT, cloud-enabled system. The platform helps food service companies automate the monitoring of quality risk factors and lowers the potential for human error. Elsewhere in the software space, Trimble acquired the assets of HarvestMark, a provider of food traceability and quality inspections solutions, in April 2015.

With consumers demanding fresher food with fewer additives and preservatives, companies are using packaging technology to keep food fresh. Modified atmosphere packaging (MAP) extends the shelf life of fresh food products by substituting the atmospheric air inside a package with a mixture of natural gases in carefully controlled proportions. The type and proportion of gas used is primarily dictated by the type of food in the package. This protective gas mix slows down the process of decay and inhibits the growth of microbes. MOCON’s technology analyzes and monitors the amount and type of gas present in packages. Other MOCON products detect leaks and measure the rate at which gases and vapors transmit through packaging material.

Automation and Robotics

As discussed in the “Advanced Robotics” section of this report on page 23, food and beverage companies are addressing rising labor costs, employee health issues resulting from repetitive motions, and costly food safety and hygiene compliance. In addition, emerging market consumers are demanding more processed and packaged foods, which is leading to accelerated investment in process automation.

Given this backdrop, robot manufacturers such as Kuka and Fanuc appear well positioned for growth. Food processing equipment companies such as Middleby are also introducing new products that address food quality and consistency concerns. Machine vision is playing a role in product quality, safety, and package integrity as well. Cognex Vision and ID products help food processors with tasks such as bottle inspection and label placement. This helps food companies manage allergens by confirming package/product match as well as traceability.

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24 Agrigenomics is the application of genomics in agriculture to improve the productivity and sustainability in crop and livestock production.
### Figure 43: Company exposure to food safety theme

<table>
<thead>
<tr>
<th>Company</th>
<th>Ticker</th>
<th>GICS Industry</th>
<th>Description of relevant business</th>
<th>Food safety Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecolab</td>
<td>ECL</td>
<td>Chemicals</td>
<td>Food &amp; beverage cleaning, sanitation and plant hygiene solutions including customized on-site evaluations, training, and quality assurance services to foodservice operations</td>
<td>High</td>
</tr>
<tr>
<td>Sealed Air</td>
<td>SEE</td>
<td>Containers &amp; Packaging</td>
<td>Packaging and hygiene solutions</td>
<td>High</td>
</tr>
<tr>
<td>MOCON</td>
<td>MOCO</td>
<td>Electrical Equipment, Instruments &amp; Components</td>
<td>Instruments that detect, measure, and monitor gases and other chemical compounds</td>
<td>High</td>
</tr>
<tr>
<td>Roka Bioscience</td>
<td>ROKA</td>
<td>Healthcare Equipment &amp; Supplies</td>
<td>Molecular assays and instrument systems</td>
<td>High</td>
</tr>
<tr>
<td>Neogen</td>
<td>NEOG</td>
<td>Healthcare Equipment &amp; Supplies</td>
<td>Diagnostic tests for food and feed producers and processors</td>
<td>High</td>
</tr>
<tr>
<td>Where Food Comes From</td>
<td>WFCF</td>
<td>Internet Software &amp; Services</td>
<td>Third party verification and traceability of food production practices</td>
<td>High</td>
</tr>
<tr>
<td>Eurofins</td>
<td>ERF.FP</td>
<td>Life Science Tools &amp; Services</td>
<td>Testing, inspection, and certification services for food safety</td>
<td>High</td>
</tr>
<tr>
<td>Manitowoc Foodservice</td>
<td>MFS</td>
<td>Machinery</td>
<td>Commercial foodservice equipment</td>
<td>Medium/High</td>
</tr>
<tr>
<td>Middleby</td>
<td>MIDD</td>
<td>Machinery</td>
<td>Commercial foodservice and industrial processing equipment</td>
<td>Medium/High</td>
</tr>
<tr>
<td>John Bean Technologies</td>
<td>JBT</td>
<td>Machinery</td>
<td>Food equipment &amp; service</td>
<td>Medium/High</td>
</tr>
<tr>
<td>bioMerieux</td>
<td>BIM.FP</td>
<td>Healthcare Equipment &amp; Supplies</td>
<td>Microbiology, immunoassays, and molecular tests</td>
<td>Medium</td>
</tr>
<tr>
<td>IDEXX</td>
<td>IDXX</td>
<td>Healthcare Equipment &amp; Supplies</td>
<td>Diagnostic, health-monitoring, and food safety testing products for livestock, poultry, and dairy; Testing and detection solutions of various microbiological parameters in water</td>
<td>Medium</td>
</tr>
<tr>
<td>Thermo Fisher</td>
<td>TMO</td>
<td>Life Science Tools &amp; Services</td>
<td>Diverse portfolio of food safety testing solutions</td>
<td>Medium</td>
</tr>
<tr>
<td>Perkin Elmer</td>
<td>PKI</td>
<td>Life Science Tools &amp; Services</td>
<td>Variety of solutions that confirm food quality and identify the origin of food products</td>
<td>Medium</td>
</tr>
<tr>
<td>Agilent</td>
<td>A</td>
<td>Life Science Tools &amp; Services</td>
<td>Products address food safety and food authenticity</td>
<td>Medium</td>
</tr>
<tr>
<td>Mettler-Toledo</td>
<td>MTD</td>
<td>Life Science Tools &amp; Services</td>
<td>Provides end-of-line inspection systems used in production and packaging for food</td>
<td>Medium</td>
</tr>
<tr>
<td>Bruker</td>
<td>BRKR</td>
<td>Life Science Tools &amp; Services</td>
<td>Nuclear magnetic resonance, mass spectrometry, and Infrared/Near Infrared instruments for food safety</td>
<td>Medium</td>
</tr>
<tr>
<td>Rational</td>
<td>RAA.GR</td>
<td>Machinery</td>
<td>Thermal food preparation</td>
<td>Medium</td>
</tr>
<tr>
<td>PAR Technology</td>
<td>PAR</td>
<td>Electrical Equipment, Instruments &amp; Components</td>
<td>Software-as-a-service solution for storing, analyzing, and reporting data for HACCP compliance purposes</td>
<td>Medium/Low</td>
</tr>
<tr>
<td>Waters</td>
<td>WAT</td>
<td>Life Science Tools &amp; Services</td>
<td>High and ultra-performance liquid chromatography and mass spec systems for food safety labs</td>
<td>Medium/Low</td>
</tr>
<tr>
<td>SGS</td>
<td>SGSN.VX</td>
<td>Professional Services</td>
<td>Agriculture, Food, and Life business lines offers testing, inspection, and certification services</td>
<td>Medium/Low</td>
</tr>
<tr>
<td>DuPont</td>
<td>DD</td>
<td>Chemicals</td>
<td>Qualicon business operates in the pathogen testing market</td>
<td>Low</td>
</tr>
<tr>
<td>Trimble</td>
<td>TRMB</td>
<td>Electrical Equipment, Instruments &amp; Components</td>
<td>HarvestMark provides food traceability and quality control solutions</td>
<td>Low</td>
</tr>
<tr>
<td>Cognex</td>
<td>CGNX</td>
<td>Electrical Equipment, Instruments &amp; Components</td>
<td>Machine vision</td>
<td>Low</td>
</tr>
<tr>
<td>3M</td>
<td>MMM</td>
<td>Industrial Conglomerates</td>
<td>Products make it faster and easier for food processors to test the microbiological quality of food</td>
<td>Low</td>
</tr>
<tr>
<td>Bio-Rad</td>
<td>BIO</td>
<td>Life Science Tools &amp; Services</td>
<td>Chromogenic and molecular tests for food pathogens, food quality</td>
<td>Low</td>
</tr>
<tr>
<td>Qiagen</td>
<td>GEN</td>
<td>Life Science Tools &amp; Services</td>
<td>Molecular testing solutions</td>
<td>Low</td>
</tr>
<tr>
<td>Illumina</td>
<td>ILMN</td>
<td>Life Science Tools &amp; Services</td>
<td>Sequence and array-based technology platform</td>
<td>Low</td>
</tr>
<tr>
<td>Kuka</td>
<td>KU2.GR</td>
<td>Machinery</td>
<td>Industrial robots</td>
<td>Low</td>
</tr>
<tr>
<td>Fanuc</td>
<td>6954.JP</td>
<td>Machinery</td>
<td>Industrial robots</td>
<td>Low</td>
</tr>
<tr>
<td>Intertek</td>
<td>ITRK.LN</td>
<td>Professional Services</td>
<td>Food &amp; Agriculture business offers testing, inspection, and certification services</td>
<td>Low</td>
</tr>
<tr>
<td>Bureau Veritas</td>
<td>BVI.FP</td>
<td>Professional Services</td>
<td>Testing, inspection, and certification services for food safety</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: Company reports, Cornerstone Capital Group. *Company exposure is based on Cornerstone estimates of current sales derived from products and services relating to food safety.
# Appendix I – Regulatory Assessment

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>China</th>
<th>European Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall approach</td>
<td>Formerly based on ‘reasonable certainty of no harm’ but FSMA introduced risk based, HACCP approach and use of auditors</td>
<td>Recent changes focus on supervision/control of food chain, enforcement, focus on problem areas (e.g. infant formula, health food, online shopping)</td>
<td>Based on ‘precautionary principle’, with evaluation undertaken by organized government bodies</td>
</tr>
<tr>
<td>Regulatory agencies</td>
<td>Food and Drug Administration (FDA) and US Department of Agriculture (meat and poultry)</td>
<td>China Food and Drug Administration (CFDA)</td>
<td>European Food Safety Authority; national regulators (e.g. French Agency for Food, Environmental and Occupational Health &amp; Safety)</td>
</tr>
<tr>
<td>Food standards</td>
<td>US focus is on adulteration and misbranding in line with existing food composition standards</td>
<td>New standards for food manufacturing and distribution but no food composition standards</td>
<td>No harmonization of food composition standards across countries</td>
</tr>
<tr>
<td>Growth hormones</td>
<td>Growth hormones approved for beef cattle with no presence to be detected at time of slaughter</td>
<td>No regulation concerning use of growth hormones but ban on the presence of hormonal growth promoters in imported animals</td>
<td>No substances that have hormonal action may be given to farm animals</td>
</tr>
<tr>
<td>Livestock antibiotics</td>
<td>FDA regulations tightened to reduce use of medically important antibiotics for growth promotion but antibiotics allowed for disease treatment and prevention</td>
<td>No regulation on use of antibiotics in livestock presently but inclusion of antibiotic use on labels included in new food safety law (2015)</td>
<td>Antibiotics use for growth promotion prohibited but allowed for disease prevention</td>
</tr>
<tr>
<td>Novel foods</td>
<td>Producers of new foods have responsibility to ensure foods are safe and in compliance with applicable legal requirements</td>
<td>Producers of new foods must submit relevant information to National Health and Family Planning Commission for review, public comment, evaluation and approval</td>
<td>Pre-market approval is required prior to novel food being provided in market</td>
</tr>
<tr>
<td>Genetically modified foods</td>
<td>GMOs are permitted in all foods and labeling is voluntary</td>
<td>There are no national laws regulating use of GMOs but labeling of GMOs in food is mandatory</td>
<td>Pre-approval required for all GMO foods; must not pose harm humans, animals or environment, must not mislead consumers. Labeling also mandatory</td>
</tr>
<tr>
<td>Cloned animal</td>
<td>No regulation but voluntary moratorium on cloned meat is in place</td>
<td>No regulation and cloned animal production is being developed</td>
<td>Pre-market approval including safety risk assessment required for all cloned animal meat and approved meat must have clear labeling</td>
</tr>
<tr>
<td>Nanomaterials</td>
<td>No specific regulation in place</td>
<td>No specific regulation in place</td>
<td>Labeling requirements</td>
</tr>
<tr>
<td>Food labeling: Allergens</td>
<td>8 major food allergens must be included on label</td>
<td>8 major food allergens must be included on label</td>
<td>14 allergens must be included on label</td>
</tr>
<tr>
<td>Protected destinations of origin</td>
<td>No program in place</td>
<td>No program in place</td>
<td>Program in place</td>
</tr>
<tr>
<td>TPP and/or TIPP</td>
<td>Party to both TPP and TIPP; major food safety element is improved linkages for food import/export on basis of ‘equivalent’ safety regime</td>
<td>Not included in either trade agreements</td>
<td>Party to TIPP with food safety focus on reducing regulatory burden for EU foods exported into US</td>
</tr>
</tbody>
</table>

Source: US Food and Drug Administration, European Food Safety Authority, China Food and Drug Administration
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