

From Farm to Fork: Investment Opportunities in Food Safety

Introduction

Food safety is a huge and growing global problem, one that is sickening millions and costing governments and industries billions of dollars. In the U.S. alone, one in six people, or 48 million, are struck down each year from foodborne diseases; 128,000 are hospitalized and 3,000 dieⁱ. Recent headlines have trumpeted news of salmonella outbreaks tied to Foster Farms chicken, cyclospora linked to restaurant greens and e-coli traced back to frozen pizza slices. *The Wall Street Journal* earlier this year told the surprising tale of a new, \$125 million infant-formula factory being built in France by a Chinese company. The reason for the European locale? More Chinese consumers are demanding foreign-made formula since a 2008 food-safety scandal involving melamine-tainted formula, which killed six babies and sickened 300,000 in China.

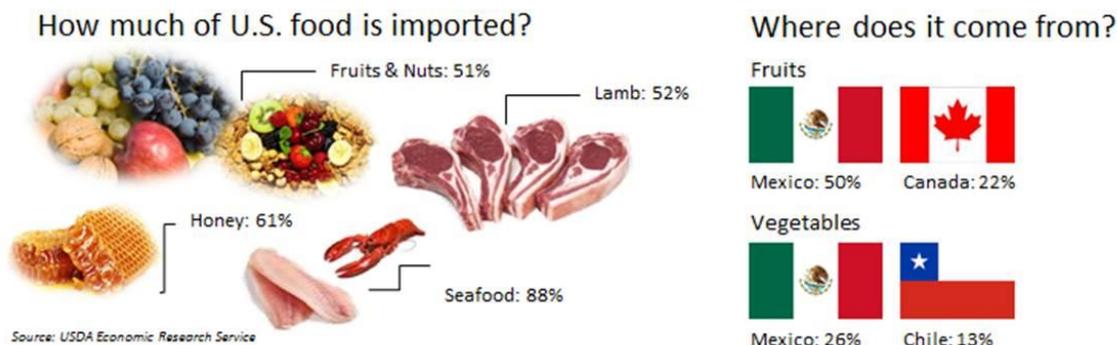
Governments, including the U.S. and its Food and Drug Administration, are stepping up efforts to police the food supply chain. But there is notable activity in the private sector as well. At Battery, we see potential investment opportunities in several areas of food safety, including food testing and analysis, packaging, and “big data” technology to better monitor food supply chains. Our firm’s experience in other areas of the industrial economy—in the last 11 years we have made more than 30 investments around industrial technology—makes us intrigued by the growing and fragmented food-safety market. What follows is our analysis of the major factors at play in the market and potential areas for investment and growth.

Why Food Safety is a Growing Problem

Several factors—both economic and societal—are driving the uptick in U.S. food-safety incidents. Perhaps the chief culprit is the increase in food imports, notably from other countries where food-safety regulations are lax and contamination risks are higher.

In the U.S. right now, more than 85 percent of seafood, 50 percent of produce and almost all spices are imported from other nations. According to Bloomberg Markets, food imports doubled in the decade before 2012 and now represent a fifth of the food Americans consume. Overall U.S. food imports grew from \$41 billion in 1999, to \$83

billion in 2008 and more than \$106 billion in 2012, according to the U.S. Department of Agriculture's Economic Research Service. Countries like China and Vietnam now account for a large portion of the seafood Americans consume; Mexico and Chile are exporting significant amounts of fruits and vegetables.



Yet according to Office of Regulatory Affairs, only two percent of imported food is actually physically inspected by the FDA. A recent North Carolina study revealed that a quarter of the seafood imported from Asia and available at retail outlets in that state had detectable levels of formaldehydeⁱⁱ. In China, several antibiotics have been found in farm-raised fish such as tilapia, as well as additives such as leuco-malachite green, which the U.S. Food and Drug Administration banned for aquaculture use in 1983 because of "serious toxicity." Three-quarters of the tilapia we eat in this country comes from China,ⁱⁱⁱ and tilapia now ranks as the fourth-most popular seafood in the U.S.

"Current food imports originate from more than 250,000 foreign establishments in 200 countries," FDA Commissioner Margaret Hamburg told a U.S. House subcommittee two years ago. "As a nation, we enjoy the benefits of, but are simultaneously put at risk by, a global food supply." At around the same time Commissioner Hamburg was making her remarks, FDA inspectors found unsanitary conditions—including microbiological contamination and "apparent bird feces"—at a big seafood exporter in southern India. Though the FDA stepped in quickly to bar the company, Moon Fishery India Pvt. Ltd., from shipping fish into the U.S., contaminated tuna from the company had already caused a major salmonella outbreak in the U.S. that sickened 425 people. The outbreak sent 55 people to the hospital. And just this summer, Chinese outlets of McDonald's and KFC restaurants were forced to stop using meat from a supplier, headquartered in Illinois, after a Chinese TV program showed hidden-camera footage of workers using

chicken and beef that was past its expiration date. The show also included scenes of workers using meat that had fallen onto the floor.

Another issue contributing to the rise in food-safety problems is consumers' increasing preference for new types of food. This includes food that's not in season (eating strawberries year-round, for instance) and more exotic foods that have now become commonplace on Americans' tables: tropical fruits, premium coffee, and imported and/or raw cheeses, to name a few examples. Today's shift toward two-earner families and increasingly busy lifestyles also has increased consumption of more pre-packaged, ready-to-eat foods, such as those found in the deli sections of big supermarkets. These food items can be dangerous because of their relatively short shelf lives and the increased opportunities for contamination introduced during the packaging process.

At the same time, the preference by some health-conscious consumers for less processed foods, such as raw milk and fresh juices, also poses a potential hazard. These products aren't cooked or pasteurized to kill potentially harmful bacteria. A CDC study, published online in *Emerging Infectious Diseases*, determined that raw milk and related milk products were 150 times more likely than pasteurized milk to cause illness. Although raw-milk products represent only about one percent of total U.S. dairy output, raw-milk dairies were linked to 60 percent of the dairy contamination issues in the study, which analyzed outbreaks during the period 1993 to 2006^{iv}.

The Government Steps In: How Food-Safety Policy is Changing

Food safety has long been a focus of the U.S. government's agriculture policy, starting with the establishment of the FDA in 1906. But in 2000, after a series of high-profile, food-safety problems, businesses pushed for the creation of the Global Food Safety Initiative, a project seeking to connect people, companies and other entities along the food supply chain to improve food-safety management systems.

Problems persisted, however. In 2009, the U.S. government began discussing stricter food-safety regulations. Early that year, President Barack Obama had taken office during one of the worst salmonella outbreaks in U.S. history; at least 714 people had fallen ill after eating tainted peanut butter, and nine died. The salmonella was traced back to the now-bankrupt Peanut Corporation of America, based in Virginia, which some accuse of knowingly shipping contaminated peanuts to food processors who made the nuts into

peanut butter. Obama vowed to fix the problem. (Though the FBI did last year name four former officials of the company in an indictment, other law-enforcement agencies found it difficult to levy stiff penalties against the company under current laws.)

In 2011, Congress signed into law the landmark Food Safety Modernization Act (FSMA). This legislation gives the FDA additional authority to regulate food facilities, establish standards for safe produce, recall contaminated foods and oversee imported foods. It also requires improvements in surveillance and response to food-contamination outbreaks, and gives the FDA powers to increase inspections of U.S. food facilities—as well as to partner with foreign governments to monitor food imports. The law touches on every aspect of the U.S. food system, from farmers to food manufacturers to importers. Notably, it places significant responsibilities on farmers and food processors to prevent contamination in the first place. This is a distinct shift from the country’s former, more-reactive policy approach, which focused on identifying and containing outbreaks after they happened.

Highlights of the Food Safety Modernization Act

Prevention	Inspection & Compliance	Import Safety
<ul style="list-style-type: none"> • Preventive controls over food and feed facilities • Prevention is not new but Congress has given FDA authority to use control more broadly • Produce safety standards • Authority to prevent intentional contamination 	<ul style="list-style-type: none"> • Mandatory inspection frequency • New tools such as: mandatory recall, expanding records access, expanding administration detention, enhanced product tracing, 3rd party laboratory testing, etc. 	<ul style="list-style-type: none"> • Importers now responsible for ensuring their foreign suppliers have adequate preventive controls in place • FDA can rely on 3rd party to certify that foreign foods meet U.S. requirements • Can deny entry if FDA access for inspection is denied • Requires imported food to be as safe as domestic

Regulators have hit some speed bumps in implementing the ambitious new law, however. The main problem is lack of funding. The legislation allows the FDA to collect a registration fee from food producers and importers to help fund the new regulatory regime, but that cash is not enough: When the law was first discussed in 2009, the Congressional Budget Office estimated that the FDA still would incur a net cost of \$2.2 billion over five years to implement the law. So since then, not surprisingly, the FDA

hasn't been able to hire enough inspectors and flex its new powers as strongly as the law's proponents had hoped.

Potential Innovators—Private Sector Answers to Food-Safety Problems

Still, experts don't believe the broader issue of food safety—and the government's push for stronger regulations, and more budget to fund them—is going away. That's why many food producers, importers and processing companies are planning ahead and considering (or already testing or using) new processes and technology to help them stay ahead of the regulatory curve. Consumers, too, continue to demand safer food. We would like to examine three specific areas of food-safety innovation where we see promise as investors: food testing and analysis; packaging; and supply-chain technology.

Food testing and analysis

Obviously, increased consumer and regulatory focus on food safety is creating more market opportunity for companies specializing in food testing and analysis. One example is **Neogen**, a publicly traded company based in Lansing, Mich. that develops, manufactures and markets products focused on food and animal safety. Products include its line of NeoFilm microbial tests (which can test for contaminants like e-coli, yeast and mold), and NeoSEEk, a meat-species identification service which can determine if horse, pig, poultry, beef or sheep meat has been adulterated.

Another notable company is privately held **CEM** of North Carolina. CEM, founded in 1978, is a pioneer in microwave chemistry and now makes products with applications in a host of industries, ranging from food testing and processing to other analytical applications such as environmental testing. Microwave chemistry has had a major impact on the life-sciences and biosciences research markets by dramatically accelerating chemical reactions. In terms of food safety, the company uses its microwave technology to test food for trace metals, which can be harmful even in small amounts if absorbed by humans. This is an increasingly important service as food manufacturers and contract laboratories are being required to analyze more and more food samples today and detect ever-lower levels of metals.

In addition to food safety, CEM develops products that can provide rapid food compositional testing for protein, fat, moisture and total ash content. CEM's technology

is unique in that, for the first time, it provides simple, direct methods that can be used at-line in processing plants for controlling these parameters. The only other technologies currently available are all indirect methods which require extensive re-calibration on a continuing basis. This new technology is being adopted on a global basis and is already having a major impact on key segments of the food industry including dairy, meat and snack foods.



Another privately held company, family-owned **Charm Sciences, Inc.** of Massachusetts, is an innovator in food-safety diagnostics and develops test kits and systems to detect antibiotics, mycotoxins, pesticides, pathogens and other contaminants in food. After Dr. Stanley Charm pioneered the first rapid antibiotic milk test in 1978, the business has built a strong brand with an expanded product portfolio to provide the dairy industry with rapid antibiotic tests to meet regulatory requirements. In addition to dairy, Charm's diagnostics tools provide equipment for feed, grain, water and environmental diagnostics. Another local Massachusetts company, **Advanced Instruments, Inc.** is a manufacturer of analytical instrumentation based on freezing-point depression technology. One of the company's markets is dairy and food laboratories. Their Advanced Cryoscope product employs the freezing-point depression method to detect the presence of added water in milk, while the Fluorophos ALP System measures the pasteurization of milk products.

Meanwhile, **Bio-Rad Laboratories, Inc.**, a publically traded company headquartered in Hercules, California, is developing advanced new molecular methods to test for foodborne pathogens. Bio-Rad's iQ-Check system "was designed to facilitate the wide-scale movement toward the use of molecular approaches for pathogen detection in food laboratories," according to the company. The "polymerase chain reaction", or PCR, detection method used by Bio-Rad and others amplifies a small piece of DNA to produce many more copies of a specific DNA sequence, which is increasingly the way scientists are testing for pathogens in food.

There are innovative companies not only in the United States but across Europe as well. Headquartered in Stockholm, Sweden **Perten Instruments** is a provider of advanced analytical instruments for the quality control of grain, flour and feed. The company focuses on two different types of tests: compositional tests, which provide diagnostics on the percentage concentration of substances such as protein, fats and oils within samples of organic materials, and functional analysis, which measures sample properties rather than constituents such as viscosity or texture. The company's products can be used across multiple segments of the agriculture industry—from farms to processing plants—for various quality-control testing. One new product from the company is the DA 7250, a third generation, diode-array based NIR instrument that analyzes samples in six seconds to determine moisture, protein, fat, ash and starch content, among other attributes. It was introduced in 2013 with a new software platform that provides an open-source calibration network, which enhances accuracy among customers globally as usage increases.

Another business with a strong brand and history (over 90 years) is New Jersey's **C.W. Brabender Instruments, Inc.**, which manufactures testing equipment that measures certain food characteristics, such as rheology (the study of the flow of matter) and viscosity. The company also manufactures quality-control instruments used in processes like baking and milling; its instruments can measure flour quality and the processing characteristics of dough, as well as test the quality of wet and dry gluten. Brabender's moisture tester can quickly determine the moisture content for all types of materials, including flour, grains and seeds.

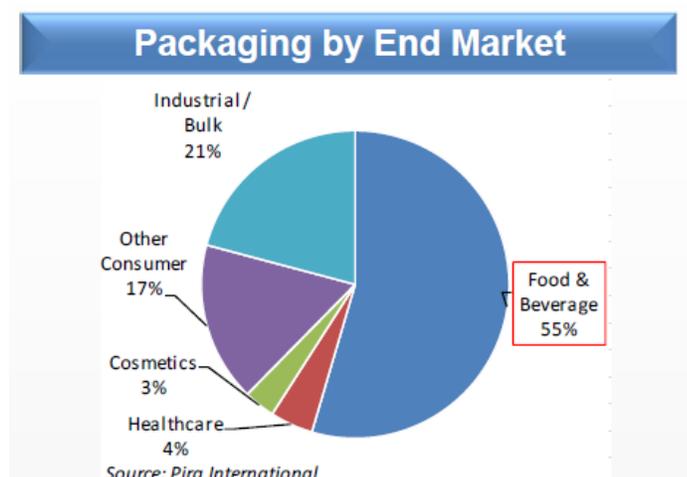
There is also a high demand for testing in specialized areas: Consumers are concerned about issues like mercury in ocean fish, for example, which could lead to more demand for mercury-sample preparation. There is also increasing interest in testing nutritional supplements, which are not currently regulated by the FDA. Overall, however, much of the innovation in food testing and analysis centers around new solutions that can give scientists faster and more accurate results when they are testing for contaminants or compositional properties.

Packaging

There are also growth opportunities around food packaging. Right now, the packaging market is a \$560 billion industry—with packaging for food and beverages making up 55 percent of it. More-modern, scientifically-advanced packaging can obviously help prevent or delay spoilage and food-borne diseases. Problems arise when milk turns sour, bread goes moldy, and meat develops a brown color and a disturbing smell. Right now, it's estimated that 25-40 percent of all fresh produce harvested will not reach consumers' tables, due to spoilage and mishandling that occurs during distribution^Y.

One specific technique called “Modified Atmosphere Packaging”, or MAP focuses on ensuring fresh and processed packaged food products maintain visual, textural and nutritional appeal. This method modifies the composition of the internal atmosphere of a food or drug package with certain gases—usually oxygen, carbon dioxide and nitrogen—in a way that can extend food shelf life without compromising the nutritional value of the food inside. Without packaging improvements, microbes can grow on food products the longer they sit on a store shelf, or in a warehouse, rendering food unpalatable or unsafe to eat. This is a complicated problem to solve, as the gas composition used to pack different food products varies significantly. Red meat needs high oxygen exposure to maintain the red color, bread requires low oxygen to avoid mold and vegetables often need a three-gas mixture.

One company pursuing innovative technologies to ensure that the gas mixture used in this process is the correct one, and to test that sealed packages contain the right mixture and do not leak, is **MOCON**. Based in Minneapolis, publicly traded MOCON tries to protect foods, drugs and beverages from outside environmental impact; specifically, it makes instruments to measure and analyze package permeation rates, package leakage and other issues. Leakage and permeation are such large food issues today because so many foods are packaged in plastic, and “all plastics permeate,” said Robert Demorest, the company's chairman and chief executive, in an interview. Glass and metal



containers generally don't have that problem. MOCON also recently added rapid "indicator organism" testing capability to its GreenLight microbial detection platform, thereby reducing test time up to 60 percent, according to the company.

Supply-chain technology

Finally, many companies are developing advanced supply-chain technology—much of it using big-data analytics—to more easily and quickly trace food safety problems to the source once they develop.

One small Seattle company, **Trace Register**, has developed software that can track, say, fish caught from a specific boat, or on a particular farm, to a certain supermarket shelf or restaurant kitchen. The company already has 800 clients in 24 countries, according to *The Wall Street Journal*. Trace Register's technology is now being used mainly by the food industry, executives say, but it has applications in many other sectors as well.

Meanwhile, **Frequenz**, a small company in Palo Alto, California, also works in the "traceability" sector and claims to track as much as 60 percent of the organic produce now produced in the U.S. Frequenz makes a product called the Information Repository & Intelligence Server, or IRIS, which it says gives organizations—ranging from manufacturers, distributors, suppliers, retailers and government regulators—visibility across the lifecycle of its product.

Others in the food supply chain are using new software in conjunction with hardware to better monitor their operations to find potential safety problems before they develop. This new approach dovetails with the more prevention-focused outlook of government agencies today, and with the FSMA. One food manufacturer, for instance, used data analytics recently to discover that its oven temperatures were inconsistent, increasing product safety risk. Operators discovered this *before* actual problems developed, and took immediate corrective action to adjust the oven temperatures, mitigating risk and ensuring product safety. Similarly, a U.S. dairy company used predictive-analytics to reduce spoilage in its dry baby formula product, which was being adversely affected by moisture. By examining data tracking content moisture, dry time and several other parameters, it was able to predict the moisture content of its product and make sure products were not spoiling.

Still other companies are developing new products that are optimized for mobile devices, so that food-industry workers can receive up-to-the-minute information about their operations anytime, anywhere.

Conclusion

Food safety is a sector primed for growth, thanks to new regulations and increased consumer concern about the origins of food products and food-manufacturing processes. Meanwhile, incidences of foodborne illnesses continue to rise, as disease-causing organisms in food are increasingly transmitted by today's interconnected global food chain.

Food safety is also an area ripe for consolidation. There are hundreds of innovative companies with between \$5 million and \$100 million in revenue that manufacture innovative microbiological, chemical and physical testing analytical instrumentation. These businesses could take advantage of a more diverse product portfolio, synergies across expanded sales channels, and benefits associated with increased scale and funding. On the early-stage side, several new venture-capital funds have sprung up recently to invest broadly in the food and agriculture sector. For example, Anterra Capital, a firm based in the Netherlands, invests in food-related companies with a focus on safety, efficiency and sustainability.

"Five years from now the industry will look completely different," said Michael J. Collins, the president and CEO of CEM, in North Carolina, in emailed comments to Battery. Collins believes that "in what has historically been a very conservative industry, major new technologies will be adopted on a broad basis to provide better food quality and safety. Global food standards will for the first time become possible using these new technologies. Innovation will flourish in this marketplace."

At Battery, we are closely tracking developments across the entire food-delivery chain and look forward to participating in that innovation.

ⁱ <http://www.cdc.gov/foodborneburden/>

ⁱⁱ <http://www.foodsafetynews.com/2013/09/formaldehyde-detected-in-supermarket-fish-imported-from-asia/#.UvUElIZnHmu>

ⁱⁱⁱ <http://www.foodsentry.org/china-and-global-food-safety-violations-a-deeper-look/>

^{iv} <http://www.foodsafetynews.com/2012/02/cdc-raw-milk-much-more-likely-to-cause-illness/#.U3tZiZL7To>

^v <http://www.camcarb.com/food-packaging.html>