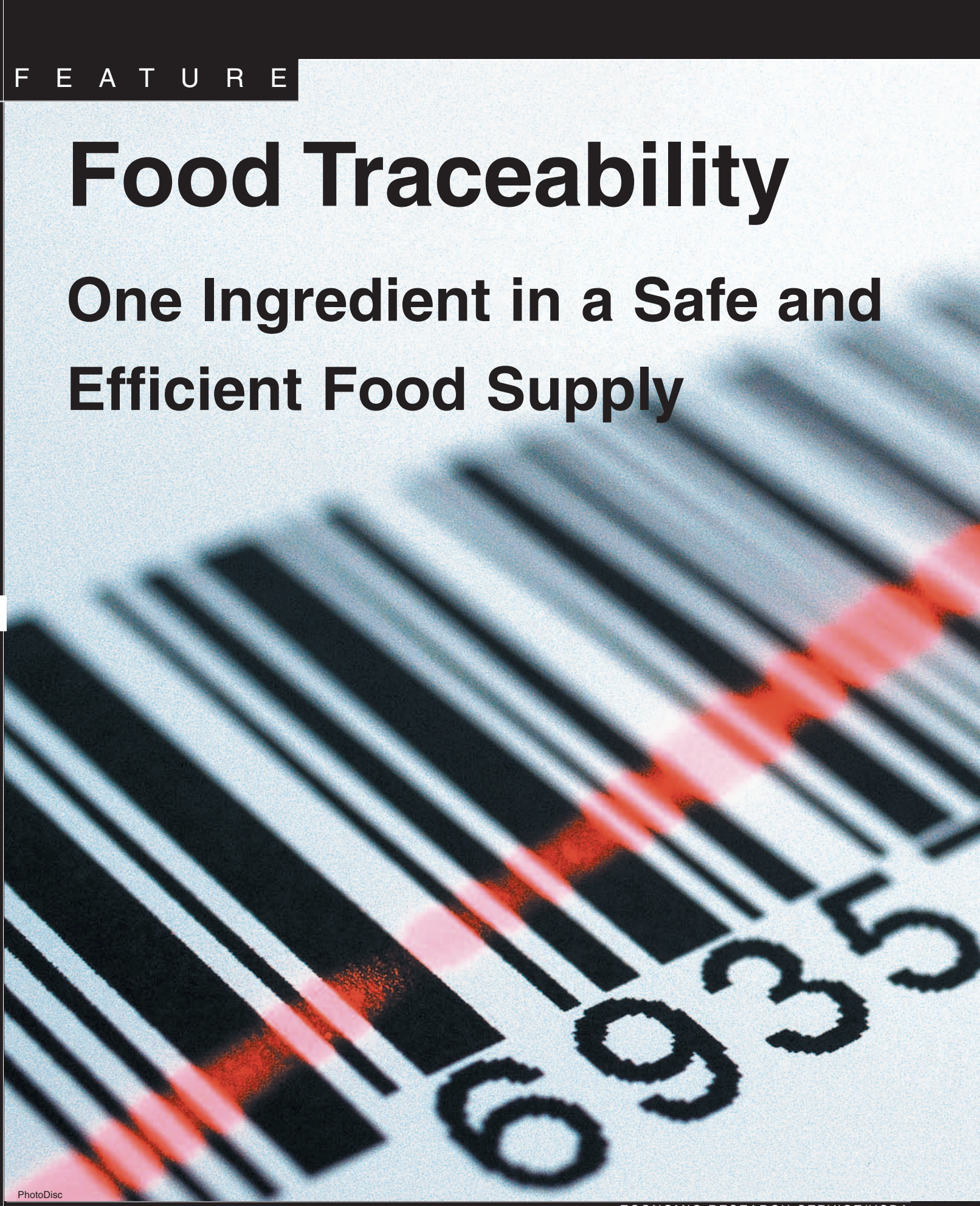
# Food Traceability

## One Ingredient in a Safe and Efficient Food Supply



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**Elise Golan**
egolan@ers.usda.gov

**Barry Krissoff**
barryk@ers.usda.gov

**Fred Kuchler**
fkuchler@ers.usda.gov

Food traceability is in the news—in articles ranging from food safety and bioterrorism to the consumer's right to know. Recent news stories have focused on tracking cattle from birth to finished product to control the risk of mad cow disease, on tracking food shipments to reduce the risk of tampering, and on traceability systems to inform consumers about food attributes like country of origin, animal welfare, and genetic composition.

Traceability is not only newsworthy, but investment worthy too. Food producers have voluntarily built traceability systems to track the grain in a cereal box to the farm and the apples in a vat of apple juice to the orchard. However, traceability is just one element of any supply-management or quality/safety control system. What exactly is traceability, how does it work, and what can it accomplish? Most important, does the U.S. food supply have enough of it?

Our examination of U.S. food traceability systems involved research into the market studies literature, interviews with industry experts, and site visits in which we interviewed owners, plant supervisors, and/or quality control managers in fruit and vegetable packing and processing plants; beef slaughter plants; grain elevators, mills, and food manufacturing plants; and food distribution centers. In some cases, we accompanied auditors for USDA procurement programs and were shown the firm's complete traceability records.

## What Is Traceability?

ISO (International Organization for Standardization), which develops voluntary international standards for products and services, defines traceability as the "ability to trace the history, application, or location of that which is under consideration." This definition is quite broad. It does not specify a standard measurement for "that which is under consideration" (a grain of wheat or a truckload), a standard location size (field, farm, or county), a list of processes that must be identified (pesticide applications or animal welfare), or a standard identification technology (pen and paper or computer). It does not specify that a hamburger be traceable to the cow or that the wheat in a loaf of bread be traceable to the field. It does not specify which type of system is necessary for preserving the identity of tofu-quality soybeans; controlling the quality of grain used in a particular cereal; or guaranteeing correct payments to farmers for different grades of apples.

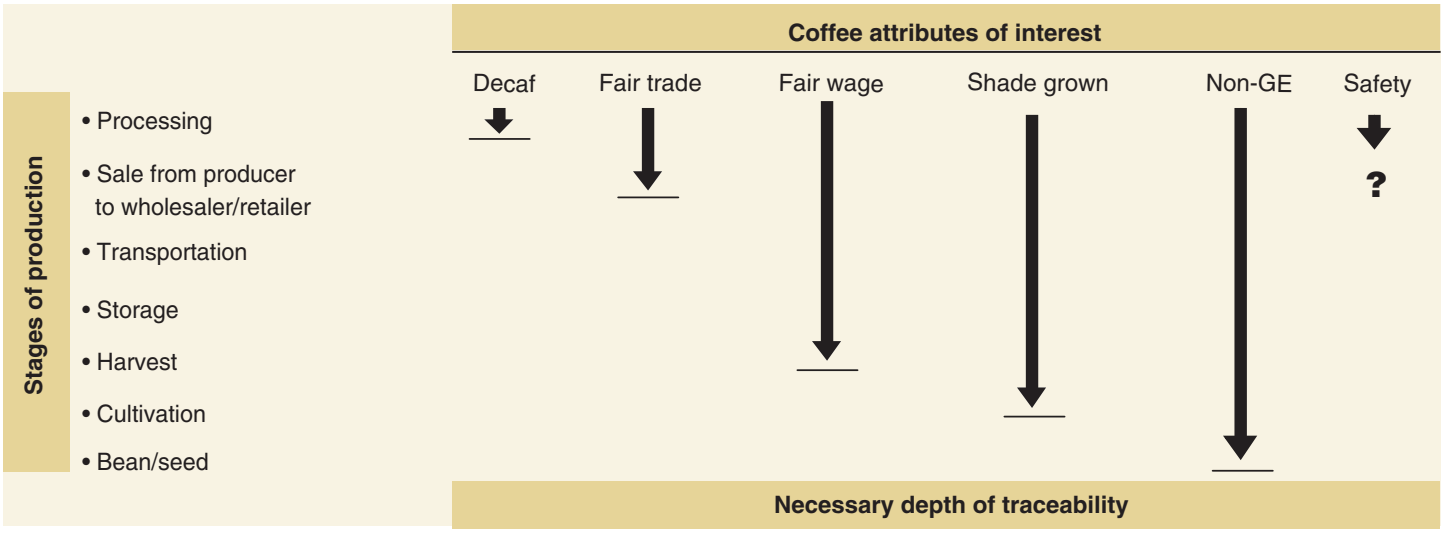

*What exactly is traceability, how does it work, and what can it accomplish? Most important, does the U.S. food supply have enough of it?*

The definition of traceability is necessarily broad because food is a complex product and traceability is a tool for achieving a number of different objectives. As a result, no traceability system is complete. Even a hypothetical system for tracking beef—in which consumers scan their packet of beef at the checkout counter and access the animal's date and location of birth, lineage, vaccination records, and use of mammalian protein supplements—is incomplete. This system does not provide traceability with respect to bacterial control in the barn, use of genetically engineered feed, or animal welfare attributes like hours at pasture and play time.

A system for tracking every input and process to satisfy every objective would be enormous and very costly. Consequently, firms across the U.S. food supply system have developed varying amounts and kinds of traceability. Firms determine the necessary *breadth*, *depth*, and *precision* of their traceability systems depending on characteristics of their production process and their traceability objectives.

***Breadth*** describes the amount of information collected. A recordkeeping system cataloging all of a food's attributes would be enormous, unnecessary, and expensive. Take, for example, a cup of coffee. The beans could come from any number of countries; be grown with numerous pesticides or just a few; be grown on huge corporate organic farms or small family-run conventional farms; be harvested by children or by machines; be stored in hygienic or pest-infested facilities; and be

**Depth of a traceability system depends on the attributes of interest**




decaffeinated using a chemical solvent or hot water. Few, if any, producers or consumers would be interested in all this information. The breadth of most traceability systems would exclude some of these attributes.

***Depth*** is how far back or forward the system tracks the relevant information. For example, a traceability system for decaffeinated coffee would extend back only to the processing stage. A traceability system for fair-trade coffee would extend only to information on price and terms of trade between coffee growers and processors. A traceability system for fair wages would extend to harvest; for shade grown, to cultivation; and for nongenetically engineered, to the bean or seed. For food safety, the depth of the traceability system depends on where hazards and remedies can enter the food production chain. For some health hazards, such as Bovine Spongiform Encephalopathy (BSE, or mad cow disease), ensuring food safety requires establishing safety measures at the farm. For other health hazards, such as foodborne pathogens, firms may need to establish a number of critical control points along the entire production and distribution chain.

***Precision*** reflects the degree of assurance with which the tracing system can pinpoint a particular food product's movement or characteristics. In some cases, the objectives of the system will dictate a precise system, while for other objectives a less precise system will suffice. In bulk grain markets, for example, a less precise system of traceability from the elevator back to a handful of farms is usually sufficient because the elevator serves as a key quality control point for the grain supply chain. Elevators clean and sort deliveries by variety and quality, such as protein level. Elevators then blend shipments to achieve a homogeneous quality and to meet sanitation and quality standards. Once blended, only the new grading information is relevant—there is no need to track the grain back to the farm to control for quality problems. Strict tracking and segregation by farm would thwart the ability of elevators to mix shipments for homogeneous product.

## What Does It Do?

Firms have three primary objectives in using traceability systems: improve supply management; facilitate traceback for food safety and quality; and differentiate and market foods with subtle or undetectable quality attributes. The benefits associated with these objectives include lower cost distribution systems, reduced recall expenses, and expanded sales of products with attributes that are difficult to discern. In every case, the benefits of traceability translate into larger net revenues for the firm. These benefits are

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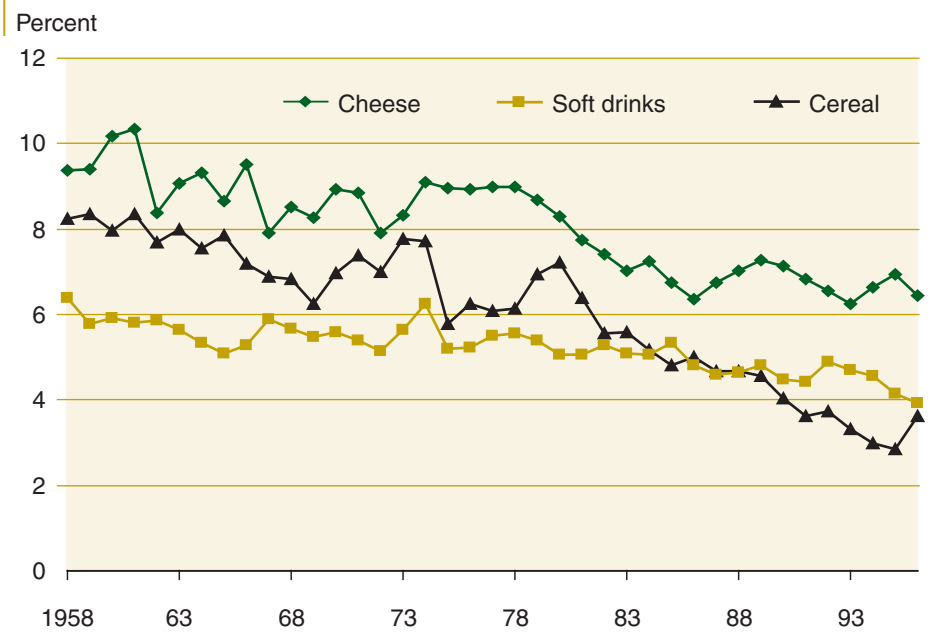
**U.S. manufacturing companies have reduced inventory-to-sales ratios. . .**


Source: Bureau of Economic Analysis, National Income and Product Accounts.

**. . .as have U.S. food manufacturers**




Source: Bartlesman, Eric J., Randy A. Becker, and Wayne B. Gray (2000). "NBER-CES Manufacturing Industry Database." www.nber.org/nberces/nbprod96.htm.

driving the widespread development of traceability systems across the U.S. food supply chain.

**Traceability to improve supply management.** Industry analysts calculate that during 2000, American companies spent $1.6 trillion on supply-related activities, including the movement, storage, and control of products across the supply chain. The ability to reduce these costs often marks the difference between successful and failed firms. In the food industry, where margins are thin, supply management, including traceability, is an increasingly important area of competition. A firm's traceability system is key to finding the most efficient ways to produce, assemble, warehouse, and distribute products.

Electronic coding systems, from the granddaddy barcode system to cutting-edge technologies like radio-frequency identification systems, are helping to streamline the U.S. food supply system. As technological innovation drives down the cost of these devices, more firms across the food supply chain are using electronic tracking systems. In some cases, buyers manage these systems to monitor internal supply flow. In others, firms establish systems that link suppliers and buyers, allowing them to automate reordering. Retailers such as Wal-Mart have created proprietary supply-chain information systems, which they require their suppliers to adopt.

Inventory-to-sales ratios are further evidence that U.S. companies are embrac-

*Advances in coding technologies are helping to streamline the U.S. food supply system.*

Ken Hammond, USDA

ing new logistic systems to better control inventory flow. The ratio of private inventories to final sales of domestic business has fallen by half since the end of WWII. The same trend can be observed in many sectors of the domestic food industry, including natural, processed, and imitation cheese; cereal breakfast foods; and soft drinks and carbonated waters. In each case, the inventory-to-sales ratio fell, with the largest decline in the cereal sector, where the ratio fell from over 8 percent in 1958 to 3-4 percent in the early 1990s. This downward trend in inventories reflects growing efficiencies in supply management in the U.S. food industry, including traceability systems. This trend is expected to continue as food manufacturers continue to adopt technologies already in use in other industries.

**Traceability for safety and quality control.** Traceability systems help firms isolate the source and extent of safety or quality control problems. This helps reduce the production and distribution of unsafe or poor-quality products, which in turn reduces the potential for bad publicity, liability, and recalls. The better and more precise the tracing system, the faster a producer can identify and resolve food safety or quality problems. One surveyed milk processor uniquely codes each item to identify time of production, line of production, place of production, and sequence. With such specific information, the processor can trace faulty product to the minute of production and determine whether other products from the same batch are also defective.

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Many buyers, including many restaurants and some grocery stores, now require their suppliers to establish traceability systems and to verify, often through third-party certification, that such systems work. The growth of third-party standards and certifying agencies is helping push the whole food industry—not just those firms that employ third-party auditors—toward documented, verifiable traceability systems.

**Traceability to market and differentiate foods.** The U.S. food industry is a powerhouse producer of homogeneous bulk commodities such as wheat, corn, soybeans, and meats. Increasingly, the industry is tailoring goods and services to the tastes and preferences of various groups of consumers. Consumers easily spot some of these new attributes—green ketchup is hard to miss. However, other innovations involve credence attributes, characteristics that consumers cannot discern even after consuming the product. Consumers cannot, for example, taste or otherwise distinguish between conventional corn oil and oil made from genetically engineered (GE) corn.

Credence attributes can describe content or process characteristics of the product. ***Content attributes*** affect the physical properties of a product, although they can be difficult for consumers to perceive. For example, consumers are unable to determine the amount of isoflavones in a glass of soymilk or the amount of calcium in a glass of enriched orange juice by drinking these beverages.

***Process attributes*** do not affect final product content but refer to characteristics of the production process. Process attributes include country of origin, free-range, dolphin-safe, shade-grown, earth-friendly, and fair-trade. In general, neither consumers nor specialized testing equipment can detect process attributes.

Traceability is an indispensable part of any market for process credence attributes—or content attributes that are difficult or costly to measure. The only way to verify the existence of these attributes is through recordkeeping that establishes their creation and preservation. For example, tuna caught with dolphin-safe nets can only be distinguished from tuna caught using other methods through a recordkeeping system that ties the dolphin-safe tuna to an observer on the boat from which the tuna was caught. Without traceability as evidence of value, no viable market could exist for dolphin-safe tuna, fair-trade coffee, non-biotech corn oil, or any other process credence attribute.

## Does the Private Sector Supply Enough Traceability?

Firms in every sector of the U.S. food supply system are investing in traceability to improve production and distribution efficiency, monitor and control food safety and product quality, and differentiate and market products with credence attributes. However, traceability systems alone do not accomplish any of these objectives. Simply knowing where a product is in the supply chain does not improve supply management unless the traceability system is paired with a real-time delivery system or some other inventory-control system. Tracking food by lot in the production process does not improve safety unless the tracking system is linked to an effective safety control system. And of course, traceability systems do not create credence attributes, they simply provide evidence of their existence.

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Firms use traceability systems together with a host of other management, marketing, and safety/quality control tools to achieve their objectives. The dynamic interplay of the costs and benefits of these tools has spurred different rates of investment in traceability across sectors—and continues to do so. Observers of this mish-mash of traceability may conclude that such variation is an indication of inadequacy. It is more accurately an indication of efficiency, the result of a careful balancing of costs and benefits coordinated by relative prices.

All of this is not to argue that companies always invest in the socially optimal amount of traceability. In some instances, the private costs and benefits of traceability may not be the same as the social costs and benefits. There are circumstances where market incentives could lead to less traceability than is desirable for product differentiation or for food safety. Both industry and government have a number of options to help correct this market failure.


Curtia Taylor, USDA/ERS

## Options To Enhance Traceability

In cases where markets do not supply enough traceability for product differentiation, individual firms and industry groups have developed systems for policing and advertising the veracity of credence claims. Third-party safety/quality auditors are at the heart of these efforts. These auditors provide consumers with verification that traceability systems exist to substantiate credence claims. For example, auditors from Food Alliance, a nonprofit organization, certify foods grown with a specific set of sustainable agricultural practices.

Government may also require that firms producing foods with credence attributes substantiate their claims through mandatory traceability systems. For example, the Government requires that firms producing organic foods verify the claim. If firms are not required to prove that credence attributes exist, some may try to gain price premiums by passing off standard products as products with credence attributes.

One difficulty with mandatory traceability proposals is that they often fail to differentiate between valuable quality attributes, those for which verification is needed, and less valuable attributes for which no verification is needed. For example, though consumers may desire verification that organic foods are indeed organic, no such verification is necessary for conventionally produced foods. There is no potential for fraud in the case of conventional foods, no danger that producers would try to cheat consumers by misidentifying organic products as conventional ones. Likewise, there is no danger that producers would try to cheat consumers by


Ken Hammond, USDA

*This article draws from the ongoing research of ERS's Traceability Team. Read more about the team and their work on page 52.*

selling non-GE (genetically engineered) soybeans as GE soybeans.

In cases where markets do not supply enough traceability for food safety traceback, a number of industry groups have developed food safety and traceback standards. For example, the California cantaloupe industry has incorporated traceability requirements in their marketing order to monitor food safety practices. In addition, buyers in every sector are increasingly relying on contracting, vertical integration, or associations to improve product traceability and facilitate the verification of safety and quality attributes. For example, many hog operations are now integrated by ownership or contractually connected to slaughtering firms. As a result, identification by herd or batch is much easier today than 50 years ago.

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Government may also consider mandating traceability to increase food safety, but this may impose inefficiencies on already efficient private traceability systems. The widespread voluntary adoption of traceability complicates the application of a centralized system because firms have developed so many different approaches and systems of tracking. If mandatory systems do not allow for variations in traceability systems, they will likely end up forcing firms to make adjustments to already efficient systems or creating parallel systems.

Other policy options give firms incentives to strengthen their safety and traceability systems without requiring any specific process for achieving these objectives. For example, standards for mock recall speed (in which firms must prove that they can locate and remove all hypothetically contaminated food from the food supply within a certain amount of time) give firms the freedom to develop efficient traceback systems while ensuring that such systems satisfy social objectives.

Policy aimed at increasing the cost of distributing unsafe foods, such as fines or plant closures, or policies that increase the probability of catching unsafe food producers, such as increased safety testing or foodborne illness surveillance, will also provide firms with incentives to strengthen their traceability systems. When the cost of distributing unsafe food goes up, so, too, do the benefits of traceability systems.

One area where industry has no incentive to create traceability systems is for tracking food once it has been sold and consumed. No firm has an incentive to monitor the health of the Nation's consumers in order to speed the detection of unsafe product. Government-supplied systems for monitoring the incidence of foodborne illness, such as FoodNet and PulseNet, are one option for helping close this gap in the food system's traceability network. Foodborne illness surveillance systems increase the capability of the entire food supply chain to respond to food safety problems before they grow and affect more consumers.

**This article is drawn from . . .**

*Traceability in the U.S. Food Supply: Economic Theory and Industry Studies*, by Elise Golan, Barry Krissoff, Fred Kuchler, Linda Calvin, Kenneth Nelson, and Gregory Price, AER-830, USDA/ERS, March 2004, available at: www.ers.usda.gov/publications/aer830/

The ERS Briefing Room on Traceability in the U.S. Food Supply: www.ers.usda.gov/briefing/traceability/