Traceability and Incentives for Food Safety and Quality: Implications for Mediterranean Crops

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What do we mean by traceability?

- Golan et al. (2003) define traceability as "*recordkeeping systems designed to track the flow of product or product attributes through the production process or supply chain*".
- Traceability systems, and their cost, differ by their *breadth*, *depth* and *precision*.
- Traceability can be a marketing or management tool, or, itself be a quality attribute valued by buyers.

Why traceability back to the farm?

Some of the many reasons often cited:

- Differentiating products by suppliers who provide traceability;
- Guaranteeing product origin when origin is an attribute of interest to consumers or others;
- Improving supply management by firms;
- Monitoring and assuring production or processing methods;
- Isolate losses from a food safety or product quality problem;
- Make liability feasible;
- Protecting or regaining the general reputation of a product, a firm, an industry or a country;
- Erect implicit international trade restrictions by increasing production costs of foreign countries.

Here we consider briefly these final three.

A prized bull in Kenya with markings to assure traceability

The fresh spinach issue was the recent major California food traceability incident

Background, *E.coli* in spinach

- On September 14, 2006, the FDA warns consumers not to eat spinach
  - One grower delivered contaminated spinach. It resulted in the largest recall of leafy green ever, 3 deaths and more than 200 illnesses.
  - Spinach rapidly traced to the Natural Selection Foods as the packer.
  - The farm of origin identified only after extensive investigation.
  - The consumption of bagged spinach was still below the previous year level six months after the outbreak while the consumption of bunched spinach had rebounded.
- A state marketing order with food safety guidelines for leafy greens was adopted and a federal marketing order is being considered and analyzed.

Worker collecting spinach for lab tests for *E.coli*

Feral pigs were a suspected source of contamination

- The cause of the contamination is still not known with certainty.
- The source of the contamination was attributed to environmental factors…

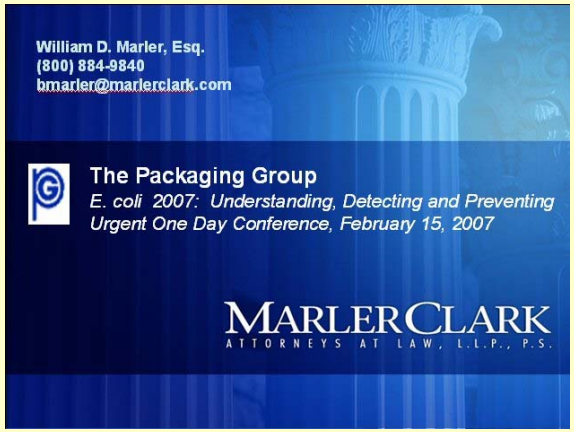
Here…

- We focus on two motivations:
  1. Traceability, liability, and incentives for food safety and quality.
  2. Traceability to protect the reputation of an industry.
- Future work: traceability and trade.

Traceability and liability

- We developed a conceptual model that shows incentives created by additional traceability and consequent liability.
- We show how and why food safety varies with:
  - Degree of traceability to marketers and farmers;
  - And, given traceability, the number of marketers and farmers.

Legal liability has become a major issue for food companies and the lawyers are on all sides



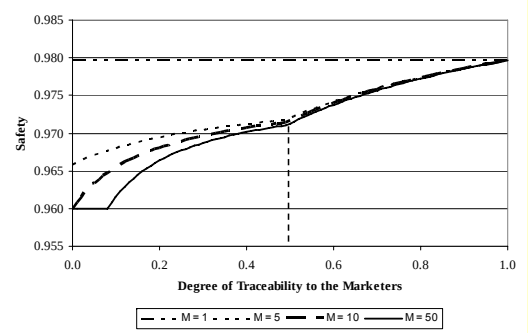
Our model setup and assumptions

- Farms (N) → Marketers (M) → Consumers (∞)
- All farms, marketers and consumers are risk neutral and homogenous.
- Traceability is measured by two probabilities:
  - Ability to trace raw material from the marketers back to farms or origin;
  - Ability to trace food from the consumers back to marketers.
- Safety of food, also a probability, depends on the probabilities that raw material is contaminated at the farms and the marketing level.

Intuition of model approach

- Traceability increases consumers' willingness to pay for food by (a) increasing the chances of receiving compensation and (b) by creating incentives for farms and marketers to supply safer food.
- For simplicity, in this model, consumers observe only the average level of food safety for a good not the safety provided by individual firms or farms.
- We consider exogenous changes in the degrees of traceability or shifts in the cost of traceability.
- Producing safer food is not free. More safety shifts up the marginal cost of food production.

Illustration: Food safety increases as traceability to the marketers increases



The number of farms is constant and equal to 300. The level of traceability to the farm is equal to 20%. The functional forms are specified in the paper.

Summary results

- Traceability from marketer back to the farm increases incentives for farms to supply safer raw materials that lead to safer consumer food.
- Traceability generally enhances the market-based incentives of private firms to provide safer food.
- Incentives for safer food are higher with fewer firms.
- Traceability contributes to solve a free-rider problem in the supply of safe food.

Traceability, industry reputation and recalls

- We develop another model to show how traceability can contribute to protect the general reputation of an industry from food safety events such as the 2006 *E.coli* tainted spinach.
- We show how profit maximizing food safety varies with respect to the degree of traceability.
- We trace the impacts of recalls that differ in scope.
- We proceed under some simplifications to keep the modeling tractable.

FDA recalls were important in the spinach case and resulted in weeks of widespread supply disruption

The long road back begins

	4 Weeks		24 Weeks	
	$ Sales	$ %-change vs. year ago	$ Sales	$ %-change vs. year ago
Packaged spinach	$4,360,849	(26.5%)	$18,685,081	(43.2%)
Packaged salad spinach	$5,776,013	(23.8%)	$23,244,218	(42.4%)
Bulk spinach	$1,264,680	(15.0%)	$5,567,536	(35.4%)
Packaged salad – non-spinach	$134,256,227	(4.6%)	$721,728,358	(8.0%)

Source: Perishables Group powered by The Nielsen Company , U.S. grocery chains (excluding Wal-Mart, club stores, small independent chains, and alternative formats such as Whole Foods and Wild Oats), for the 4 weeks and 24 weeks ended February 24, 2007.

Some basic model specifications

- A finite number of firms (N) sell to many buyers (∞).
- Firms are homogenous.
- Each unit of food from firm i has a given probability π_i of being safe, problems are random.
- When a firm delivers traceable an unsafe product, its output is recalled and that firm is not paid.
- If the product is not traceable, then output of all firms is recalled, even the safe food;
- Therefore, with a recall but no traceability, no one is paid.

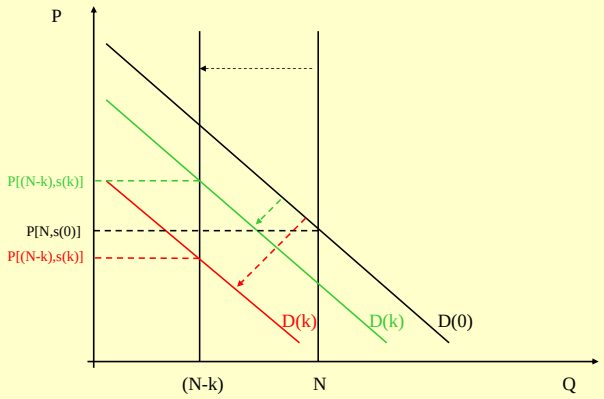
Some Model Specifics

- The confidence of consumers in the industry, $s(k)$, is a decreasing function of the number of firms delivering **unsafe** food, k.
- The equilibrium price for safe and traceable food depends on the confidence of consumers, $s(k)$, and the quantity of food marketed $(N-k)$.
- When a firm delivers safe food, it is paid

$$P\left[(N-k), s(k)\right],$$

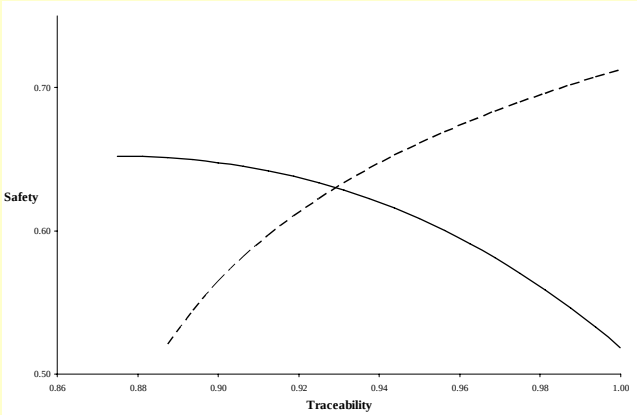
with $\frac{\partial P\left[(N-k), s(k)\right]}{\partial (N-k)} \frac{\partial (N-k)}{\partial k} > 0$ and $\frac{\partial P\left[(N-k), s(k)\right]}{\partial s(k)} \frac{\partial s(k)}{\partial k} < 0.$

Illustration of the basic structure



Simple model results

- Firms choose more food safety than what is profit maximizing for the industry when consumers react only moderately to food safety events.
- If the food safety chosen independently by firms is larger than the profit maximizing level of food safety for the industry, better traceability does *not* induce firms to choose less food safety closer to the industry (cartel) optimum.
- Therefore, better traceability can have an ambiguous effect food safety and profits.



Dashed line is the profit maximizing food safety for individual firms.
Continuous line is the profit maximizing food safety for the industry cartel.

Traceability and trade

- Food traceability has been an issue in recent WTO negotiations.
- European Union Regulation No. 178/2002 contains traceability requirements for all food.
- The recent case of contaminated pet food from China emphasized the lack of traceability for traded food:
  - Pet food ingredients from China were processed in Canada and exported to United-States.
- Other examples include tainted strawberry and tainted cantaloupe from Mexico.
- U.S. homeland security officials were surprised to find that they could not trace all imported food ingredients back to their origins, but this is not possible for domestic foods either.

Typical reaction to food safety issues in international trade

Traceability and trade in food ingredients

Effects of traceability on trade? Research issues

- Are costs of traceability higher in developing countries?
- Are legal liabilities harder to establish across borders?
- Does traceability affect the type of product traded, i.e. bulk vs. processed?
- Is traceability a technical barrier to trade?

Concluding Remarks

- Food safety and traceability have lept to the front of the food policy agenda.
- These issues are particularly salient for fresh produce;
- But, as the pet food issue illustrated, tracing all food ingredients in a processed product is even more challenging.
- Consumers will demand ever more assurances.
- Food traceability is a current and an important topic of research for agricultural economists.
- More work has to be done, in particular empirically. The lack of data poses a problem.
- Final note: Neither traceability nor local production at small scale assures safety. Small farms and small processors sometimes have the largest food safety problems.

Discussion of the illustration (Basic structure)

- The recall of the output of *k* firms shifts the supply to the left.
- The announcement of a food recall shifts the demand to the left because consumers loose confidence.
- In the case illustrated in green, the shift in the demand is *small* compare to the shift in the supply such that the equilibrium price is *higher* when a recall occurs.
- In the case illustrated in red, the shift in the demand is *large* compare to the shift in the supply and the equilibrium price is *lowe*r when a recall occurs.