Public Goods, Hysteresis and Underinvestment in Food Safety

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Objective

Explain why growers did not make the investment required to prevent food borne disease outbreak in spinach.

Role for Policy

- I am an economist
- As a Ph.D. student, Hoover tower looked down on my office
- As a Professor of Agribusiness, I conduct research on and teach about market solutions to policy problems
- I believe, and I understand that markets work well
- The U.S. fruit and vegetable sector is the best example of that
- However, markets do fail in some important cases:
  - Externalities - pollution
  - Asymmetric information - healthcare, mortgages
  - Monopolies - OPEC
  - Public goods - national defence, border security, food safety

Explanations for Underinvestment

Explanations for underinvestment:

1. Free riding on others' efforts to maintain a safe food supply - the market fails
2. A hysteretic effect that arises from the real option embedded in food safety investments - no market failure

- Much of the existing research is on the demand for food safety: Willingness to Pay
  - Hayes, et al. (1995): $0.70 per meal
  - Lusk, et al. (2006): 76% premium for antibiotic-free meat
  - Roe and Tiesl (2008): $0.80 per lb of hamburger
- This study takes a supply-side perspective
- Cost-Benefit Criteria: *Net Present Value (NPV)* - Invest if expected present value of potential savings > initial investment.
- Problems:
  - Ignores potential savings that can accrue to the industry as a whole.
  - The potential returns to investments in food safety are inherently uncertain.

- Food Safety is a specific type of public good
  - A pure public good is non-rival in consumption and non-exclusive in use
  - Can't prevent anyone from using it, and can't reduce their enjoyment if others use it
  - Examples: national defence or border security
- Food Safety is a "weaker link" public good
- If produce from another grower gets contaminated everyone suffers.
- $\Rightarrow$ Food safety investments are possibly "weakest link" or at least "weaker link" public goods.

- *Weakest link public goods* mean that the total amount of the public good is the lowest contribution: dike example
- *Weaker link public goods* mean that each contributor still receives part of the total benefit: insect control

- Hysteresis is the perpetuation of a decision when its original rationale has gone away
- Hysteresis arises if there is a real option value in the investment
- Current returns have to rise above real option to make immediate investment worthwhile
  - Example: removing Red Delicious apples and planting Pink Lady apples
- Logic: if there is a chance that prices will rise again, stay with what we have
- An investment will have a real option if it has three attributes:

1. Uncertainty in returns,
2. Fixed investment,
3. Unique opportunity to invest.

- Do the three conditions apply to food safety?
- Uncertainty? Yes, do not know when outbreak will occur
- Fixed Investment? Yes, personnel, planning, audits
- Unique opportunity? Yes, growers / handlers own their firms

Economic Model

- We construct an economic model of the NPV of investing in food safety technology.
- Incorporate realistic features including:
  - Uncertain and volatile returns to growing spinach.
  - Uncertain chance of a future food borne disease outbreak.
  - Contribution of one farm to industry-level efforts to prevent disease outbreak.
- Determine whether hysteresis or public good explain more of the apparent unwillingness to invest.

Economic Model of Food Safety Investment

- Timing of the investment is the decision variable.
- We compare the timing of an investment in food safety under three scenarios:

1. No option value, no free ridership,
2. Option values, no free ridership, and
3. No option values, and free ridership.

Case Study: CA Spinach

- 2006 - 2009
- Sickened over two hundred people and led to 3 deaths.
- Estimated costs to the industry: $100 - $200 million.
- Quantity sold fell by almost 50%.
- Prices went from $0.486/lb. to $0.197/lb. during incident
- Resulted in a reduction in total industry revenue of 79.1%.
- Likely long-term erosion in goodwill (demand): 10%.

Case Study: CA Spinach

Avoiding the outbreak

- Investment cost of Food Safety program: $4.5 million. Includes:
  - Detection technology
  - Safety Staff
  - Establishment of industry-wide certification
  - Shared by all 120 firms.
- With the following effects:
  - Reduce the probability of a one time outbreak.
  - Prevent the erosion of goodwill.

Appropriateness of Case Subject

- Findings likely to generalize to other industries
- Recent experience with disease outbreak
- Data on costs / benefits of food safety investment
- Compare to observed response from industry
- High-value example

Assumptions

- Returns are equal to the value of the avoided loss
  - Loss of returned product
  - Loss of goodwill and reputation
- Cost of the investment is initial set-up cost
- Assume an amount of investment that would prevent future losses
  - Equal to cost of setting up CA / AZ LGMAs
- Firms invest their proportionate share in benchmark scenario
- Timing is the decision variable: When to commit?

Assumptions and Method

- Estimate volatility of returns to spinach production
- Calculate value of embedded real option
- Calculate delay in investment at range of cost values
- Compare results to competitive (NPV) benchmark

Assumptions and Method

- Weaker link investment means marginal benefit greater for small contributors, but not zero for anyone
- Investment amount maximizes current-year profit
- Investment amount is the initial cost of food safety program
- Amount depends on number of firms in the industry
- Assume protection is same for everyone: 10% lower chance of outbreak
- Simulate returns process and calculate when initial investment is covered

Results of the Returns Equation

- Estimate suggest that a shock to demand can be expected to occur 0.59 times during every 288 week period, or approximately once every ten years.
- When a shock does occur, returns are expected to fall by 10.7%, on average.
- Finally, spinach returns revert to the long-term mean at a rate of 34.2% per week, which implies that any deviation is fully removed within three weeks.

Real Option Values: Investment in Safety

- Baseline real option value = $11.4 million: 253.5% of usual NPV
- Option values sensitive to:
  - Initial investment amount: option falls with investment
  - Volatility assumption: option rises with volatility
- Time to invest:
  - Baseline case: 2.22 weeks
  - Hysteresis: 7.17 weeks
  - Public Good: 11.02 weeks
- Public good effect is much stronger
- Both effects can explain delay

Hysteretic v. Public Good

- Free rider will not invest until week 11.
  - 154% longer than the real option assumption, and
  - 496% longer than under NPV investment rules.
- Size of investment effect:
  - $1.5 million: 1.89 weeks, 6.84 weeks, 1.97 weeks
  - $7.5 million: 2.43 weeks, 7.24 weeks, 18.43 weeks
- Number of firms effect (public good only):
  - 40 firms: 4.32 weeks
  - 120 firms: 11.02 weeks
  - 200 firms: 14.51 weeks
- Investment occurs earlier with fewer firms

Conclusion

- Real option gives rise to a hysteretic effect.
- Weaker link public good effect is more important
- Both effects depend on size of initial investment
- The public good effect depends critically on the structure of the market.

How to reduce the lag?

- Force growers to be responsible for uncertainty
  - Increase fines for violation
  - Develop / implement better trace-back technology
  - Increase funds for federal testing
- Reduce likelihood that individuals will be wiped out
  - Increases probability that they will contribute
  - Removes growers "beyond hope"
- Reduce the initial cost of investment
- Institute mandatory or voluntary marketing agreements
  - Use CLGMA example
  - Cooperative efforts reduce free-rider effect