An Overview of Economic Evaluation of Agricultural Research

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Objectives

- Economic evaluation **issues**
- Economic evaluation **methods**
- Economic evaluation **results**
- Observations and suggestions

Economic Evaluation **Issues**

- Multiple objectives
- Long term investment
- Level of aggregation
- Counterfactual
- Retrospective versus prospective

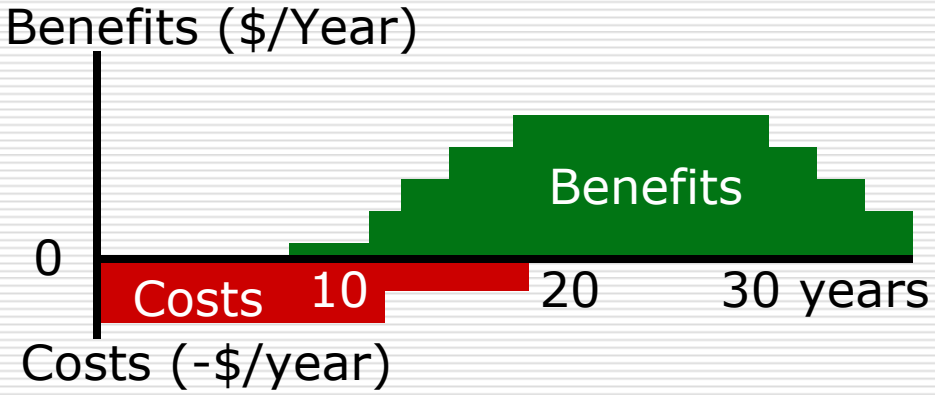
Issue: Multiple objectives

- Productivity
- Environment
- Health/nutrition
- Security

Tradeoffs among objectives; effects on some are more difficult to measure and value than on others

Issue: Long term investment

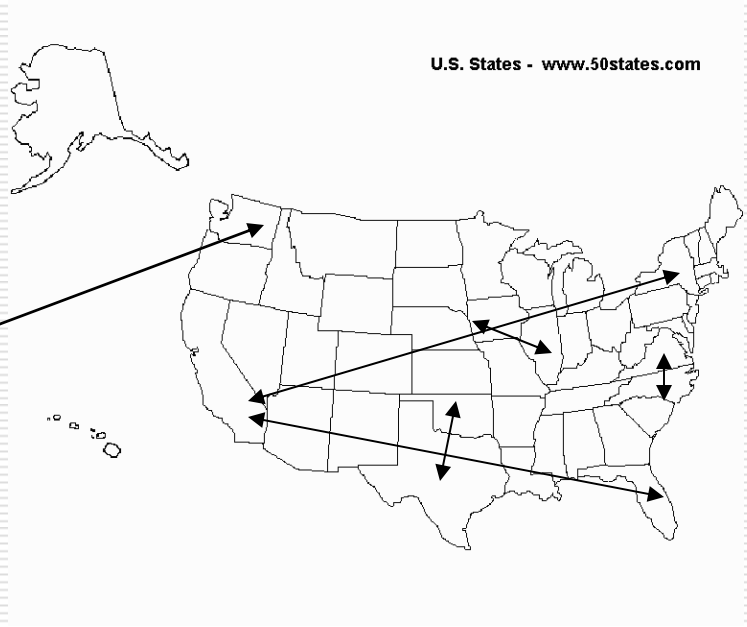
- Research lags
- Adoption lags
- Depreciation



- Research knowledge pays off over a long period of time, depreciates, and requires maintenance
- Estimating lags is crucial in research evaluation

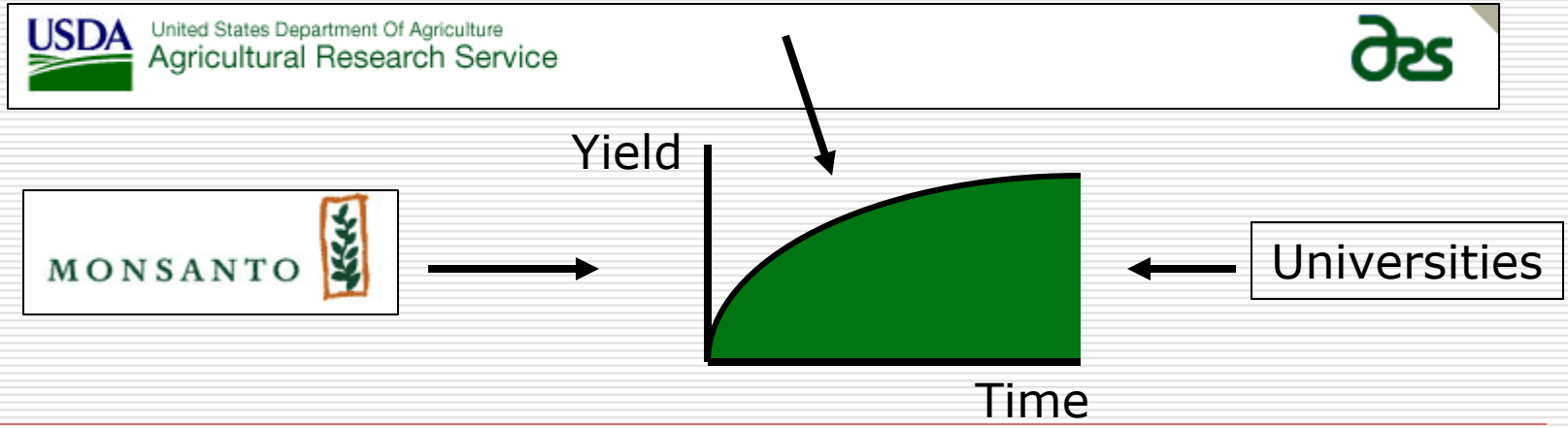
Issue: Level of aggregation

- Project, program, portfolio
- Parallel, serial, unrelated projects
- Field, farm, **market**
- Research Spillovers



Issue: Counterfactual

- Isolating what would (have) occur(red) without the research
- Attribution – Isolating effect of ARS research from other public and private research



Retrospective versus Prospective

- Evaluation methods can be similar, but data will differ
- Often the analysis is **both** R and P
- Probabilities are key in prospective case

(Probability of research success) X E(Cost change per unit) X E(Adoption rate$_t$)

Economic Evaluation: **Methods**

- Econometric (and B/C analysis)
  - Good for estimating aggregate benefits with historical data
  - Considers effects of other investments
  - Considers both failures & successes
- Economic surplus (and B/C analysis)
  - Can disaggregate benefits by group
  - Can measure ex post or ex ante benefits
  - Good for measuring effects of technologies

Econometric (regression-based)

Example:

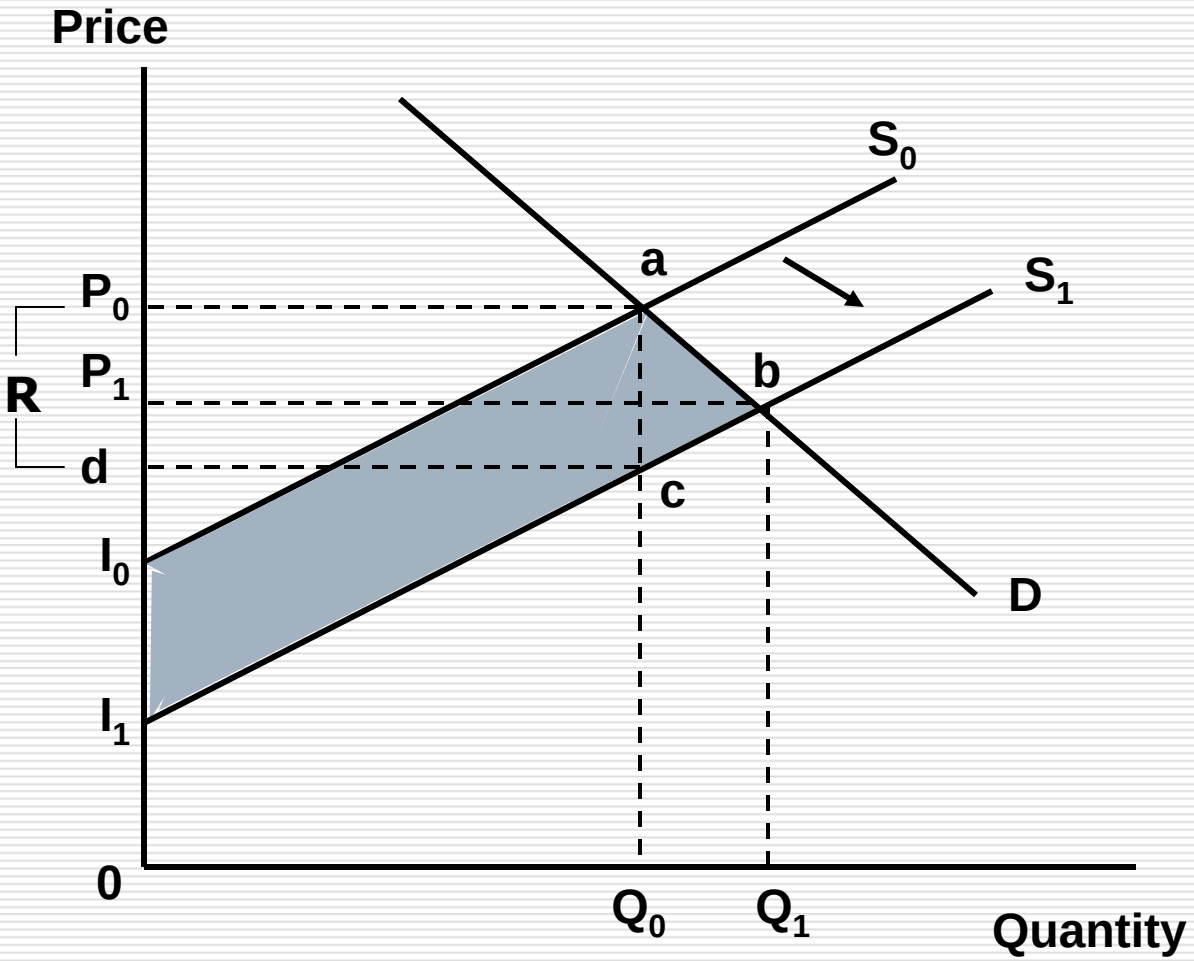
Production function approach

Y = (L, N, K, R)

R = research expenditures

Research is included with a lag and the resulting marginal product is discounted over time

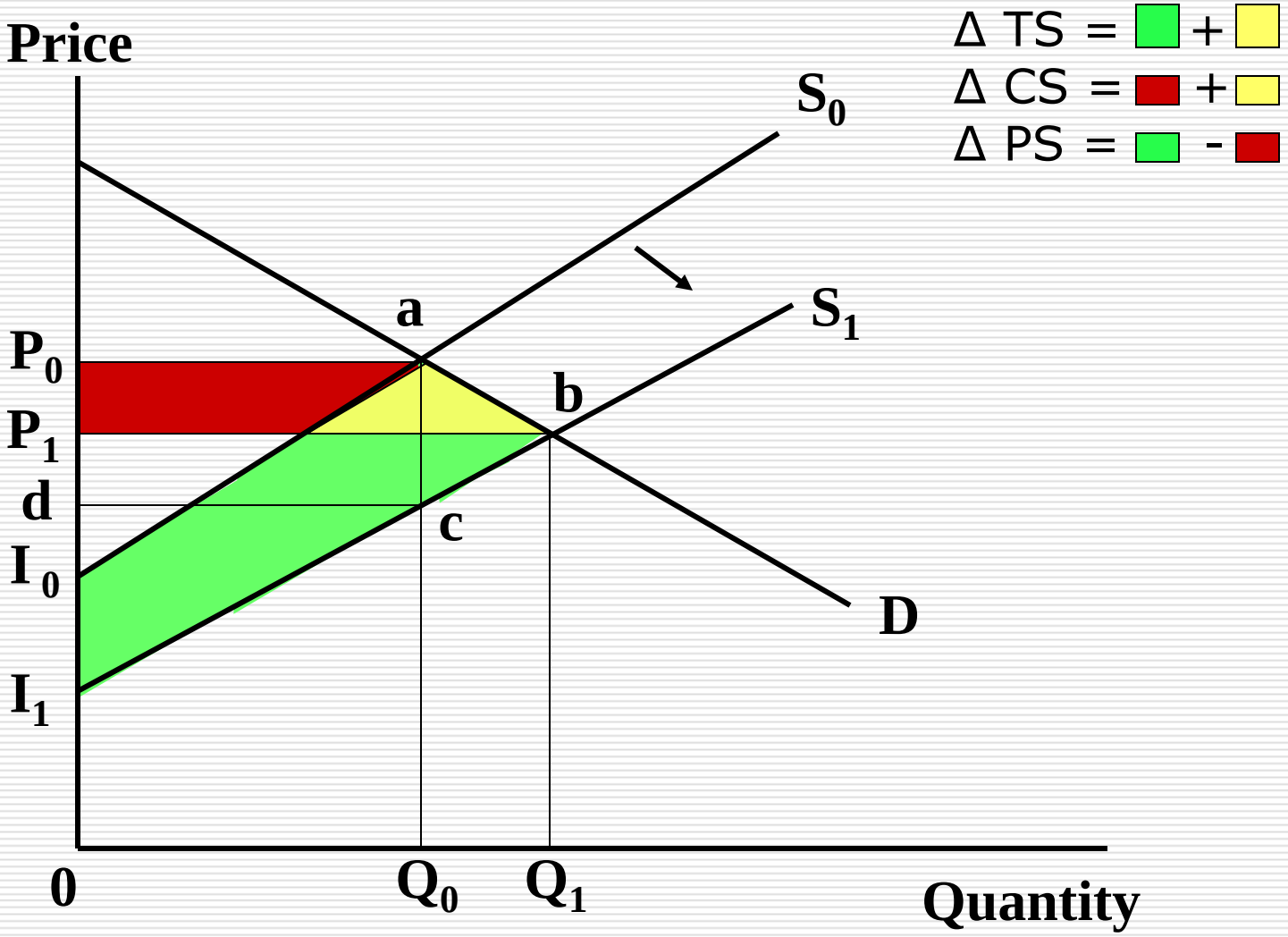
Economic surplus



$B_t = P_1Q_1K(1+.5Ken/(e+n)) =$ 

Where: (1) $K = \Delta P/P_1$ reflects yield and cost changes, Tech adoption, prob of success, (2) e and n = supply and demand elasticities (reflect slopes of D and S)

Economic surplus



Present value

- Discounting Benefits and costs

$$NPV = \sum_{t=0}^{T} \frac{(B_t - C_t)}{(1+r)^t}$$

$$IRR: \quad \sum_{t=0}^{T} \frac{(B_t - C_t)}{(1+IRR)^t} = 0$$

Steps in economic surplus analysis

- Define technology domain
- Define markets
- Estimate yield and cost changes
- Define research and adoption lags
- Apply economic surplus formulas
- Identify R&D costs
- Discount benefits and costs

Methods for assessing impacts on environment, health, nutrition

- Assess research-induced physical or biological changes first
- Can require a technique for valuing changes not priced in a market
  - Cost of averting or repairing damage
  - Inferring demand from other behavior
  - Stated values from survey or experiment

Economic Evaluation: **Results**

- Griliches: 1958 hybrid corn study found 35-40% rate of return (first study)
- **Since then, dozens of aggregate studies in U.S., with mean rate of return around 50% and most falling in 20-60% range**
- Hundreds of project or "technology" impact studies with a much wider range of estimated benefits (winners and dry holes)
- See **Fuglie and Heisey (2007)** for a recent summary of rates of return

Results: Non-market impacts

- Fewer quantitative studies but some

One Example:

- Mullen et al (1997) used a stated preference technique to value reduction in pesticide risk due to IPM program on peanuts. $844,000 estimated annual benefit in Virginia.

Observations and suggestions

- Useful to periodically measure **aggregate** economic impacts of agricultural research to help justify overall budget (GAO)
- Not feasible to quantify impacts of all projects, but useful to have **examples**
- **Portfolio** analysis should be kept simple because of difficulty in disaggregating benefits across all projects
- Economic principles can help guide portfolio selection even if impacts not all quantified

(Probability of Success X Potential Benefits X Projected Adoption)