ANH 101
Core Disciplines in Agriculture-Nutrition-Health Research

20th June 2016

Leverhulme Centre for Integrative Research on Agriculture and Health
Session 1: Economics

Mehroosh Tak
Soledad Cuevas
Mieghan Bruce
What is Economics?

**Adam Smith** “an inquiry into the nature and causes of the wealth of nations,"

**Alfred Marshall (1890)** “examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing.”

**Lionel Robbins (1932):** Allocation of scarce resources to alternative uses
Psychology, Sociology, Biology, Anthropology

Mainstream

Neoclassical

Orthodox

Heterodox
Positive and Normative Economics

**Positive** → Statements about associations, cause and effect. Are meant to be objective and verifiable.

“The cost of controlling disease in livestock is smaller than the benefit obtained” “Increased public investment in disease control increases early detection rates”

**Normative** → Statements that can incorporate value judgements, explicitly stem from a specific philosophical perspective or opinion

“The government should be responsible for pathogen control in livestock”, “everyone should have access to a healthy and affordable diet” “each person should be considered the best judge of their own preferences”
Agricultural Economics
• Economics for Agriculture
  – Agriculture sector and economic growth relation
  – Agriculture for poverty reduction and improved nutrition

• Methods
  – Impact assessment and programme evaluation
  – Counterfactual approach
  – Selection Bias
  – Finding a counterfactual
• “Most of the people in the world are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world's poor people earn their living from agriculture, so if we knew the economics of agriculture we would know much of the economics of being poor.”

  - Theodore Shultz in his acceptance speech for the 1979 Nobel Prize in Economics
Agriculture and Economic Growth

• There is an inverse relationship between per capita GDP and the percentage of labour force in agriculture

• In 2003

<table>
<thead>
<tr>
<th>Country</th>
<th>Labour Force</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK/USA</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>South Korea</td>
<td>12.5%</td>
<td>6%</td>
</tr>
<tr>
<td>Brazil</td>
<td>20%</td>
<td>9%</td>
</tr>
<tr>
<td>China</td>
<td>54%</td>
<td>20%</td>
</tr>
<tr>
<td>India</td>
<td>67%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Source: Bhaduri (2003)
Agriculture and Poverty Reduction

- Three main links between agriculture and poverty reduction (Thirtle et al, 2001)
  - Income from farms
  - Income from wage labour (not all farm workers are farmers)
  - Lower food prices
- GDP growth in agriculture is twice as effective as in other sectors at reducing poverty – World Bank 2008
- Various studies find a yield increase of one-third might reduce poverty by 25%
  - Irz et al (also in Ashley & Maxwell)
Agriculture and Nutrition

• Links
  – Own production pathway
  – Income pathway
  – Food prices
  – Market pathway (purchase via income)
  – Gender pathway
Agriculture and Nutrition

• But these are changing as structure of food systems change
  – Food market globalisation
    • Global food markets influence local diets
  – Modernisation of food value chains in developing countries
    • Inclusion of smallholders? – poverty linkages
  – Climate change
    • Will it force us to make new production decisions and how this will change our food habits?
Methods

• Impact assessment and programme evaluation
  – Examples include new rice irrigation technology
  – Or impact of food price rise on farmers and consumers

• Objective
  – Extent of adoption
  – Average effect of adoption
    • Increase in rice yields due to irrigation scheme
    • Changes in calorie intake
• Challenges

  – Adoption rate
    • Fairly simple to estimate using survey data

  – Impact on outcomes of interests
    • Estimating effect on correct population
      – A sub-population may be more likely to adopt over others
    • Establishing causality
      – Differences between observed versus unobserved characteristics

  • Spillover effect of intervention
• Counterfactual approach

\[ D_i = \begin{cases} 1 & \text{if individual } i \text{ participated in the programme} \\ 0 & \text{otherwise} \end{cases} \]

• Di =1 is treatment group or adopters
• Di =0 is control group or non-adopters

– ‘What if’ question

\[ y_i = y_{i0} + D_i (y_{i1} - y_{i0}) \] (1)

That is, for individual i we observe EITHER \( y_{i0} \) OR \( y_{i1} \), BUT NOT BOTH!
Methods

• Selection bias
• Randomisation
• Finding a true counterfactual
  – Selection on observables
    • Propensity Score Matching (PSM)
  – Difference –in-difference (DID)
• Matching
  – Method compares outcomes of treated group with similar observations from the control group based on observed characteristics
Methods

• Difference-in-difference (DID)
  – Take the difference pre and post programme data for both treated and control groups
  – Panel data
  – Controls for the time-invariant characteristics of farmers when comparing treated group with control

• Cross-sectional approaches require that, after controlling for observable characteristics, the 2 groups would have same expected outcomes in the absence of treatment

• While DID approach instead requires that after controlling for observables, the change in expected outcomes between pre and post-adoPTION surveys would be the same in the absence of adoption.
• Measures of impact
  – ATE: average treatment effect
    • Average impact of intervention on outcome variable
    • Estimated by taking the average $y_{i1}$ of treatment group and $y_{i0}$ of untreated group
  – ATT: average treatment on the treated
  – ATU: average treatment on the untreated
  – LATE: local average treatment effect
    • estimation of the average treatment effect to the subpopulation of “compliers”, that is the potential participants of intervention
      \[
      ATE = p \cdot ATT + (1 - p) \cdot ATU
      \]
    • Where $p$ is the proportion of population in the treatment group
Health economics in agri-health research

Soledad Cuevas and Laura Cornelsen

Is this intervention worthwhile, compared to a specific alternative?

Costs

Agricultural Intervention

Health Outcomes (Mortality Morbidity)

Decision Making
Health economic impacts and cost-effectiveness of aflatoxin-reduction strategies in Africa: case studies in biocontrol and post-harvest interventions

F. Wu* and P. Khlangwiset

Department of Environmental and Occupational Health, University of Pittsburgh, 100 Technology Drive, Pittsburgh PA 15219, USA

(Received 12 June 2009; final version received 23 October 2009)

Advances in health economics have proven useful in evaluating the cost-effectiveness of interventions, where the benefit usually takes the form of improved health outcomes rather than market outcomes. The paper performs health-based cost-effectiveness analyses of two potential aflatoxin control strategies in Africa: (1) pre-harvest
How cost-effective is biofortification in combating micronutrient malnutrition? An *ex-ante* assessment

Costs

Programme implementation
  Fixed (infrastructure, equipment)
  Variable (salaries, energy use)
Set-up costs (organization, administrative)

Health related costs or cost-savings
  Productivity
  Labour supply
  Health Care costs
Indirect and intangible costs
Evaluation of agricultural interventions: Cost benefit

<table>
<thead>
<tr>
<th>Measures</th>
<th>Cost / Effectiveness</th>
<th>Cost / Utility</th>
<th>Cost / Benefit</th>
</tr>
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<tbody>
<tr>
<td>YLG Cases detected Etc.</td>
<td>QALYS DALYS</td>
<td>Value of a statistical life WTP per QALY</td>
<td></td>
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### Cost Effectiveness

<table>
<thead>
<tr>
<th></th>
<th>Aflatoxin Reduction in Maize</th>
<th>Aflatoxin Reduction in Groundnut, post-harvest</th>
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<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>1 million$</td>
<td>20 million $</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>10000 cases prevented</td>
<td>40000 cases prevented</td>
</tr>
<tr>
<td><strong>Ratio (ICER)</strong></td>
<td>100$/case prevented</td>
<td>50$/case prevented</td>
</tr>
<tr>
<td><strong>Comparison</strong></td>
<td>????</td>
<td>????</td>
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*Hypothetical figures, the case of aflatoxin is only used as illustrative of the concepts*
## Cost utility

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<th>Aflatoxin reduction in Groundnut, post-harvest</th>
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<tbody>
<tr>
<td>Cost</td>
<td>60 million</td>
<td>80 million $</td>
</tr>
<tr>
<td>Outcome</td>
<td>200,000 DALYs</td>
<td>400,000 DALYs</td>
</tr>
<tr>
<td>Ratio (ICER)</td>
<td>30$/$DALY</td>
<td>20$/$DALY</td>
</tr>
<tr>
<td>Comparison Ranking</td>
<td>2(?)</td>
<td>1(?)</td>
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Methodological approaches and policy making

Inequality?
Political power?
Changing preferences and cultural norms?

Is reductionism always a problem?
Economics of Animal Health and One Health

Mieghan Bruce, Pablo Alarcon, Barbara Häslar, and Jonathan Rushton
Key concepts
<table>
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<th>Animal Health</th>
<th>One Health</th>
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<tbody>
<tr>
<td>• The “physical, mental and spiritual well being of an individual animal” AND</td>
<td>• The health of people, animals and the environment are inextricably linked.</td>
</tr>
<tr>
<td>• A “state of maximum economic production”</td>
<td>• Requires “the integration of relevant sciences at the systems level”</td>
</tr>
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(Martin, 1987) (Häsler et al, 2014)
FOOD SYSTEM

- Disease transmission and impact?
- Rules and incentives?
- Risk perceptions?
- Uncertainty?
Disease impact

Example: Mitigation Strategies for Foot and mouth disease

1. Farmer does nothing
   - **Farmer**: least cost option - affect on productivity is less than cost of control
   - **Society**: loses international trade of livestock and livestock products

2. Government imposes depopulation of the farm
   - **Society**: least cost option - avoid further disease spread and markets unaffected
   - **Farmer**: loses all their stock
Economic methods and tools used in animal health and one health
Economic methods

Assessing disease impact - orthodox
• Gross margin
• Partial budgeting
• Production function
• Cost-benefit analysis
• Cost-effectiveness analysis

Assessing risk and uncertainty – mixed methods
• Sensitivity analysis
• Break-even analysis
• Decision tree analysis

Assessing behaviour and risk perception – heterodox
• Agent-based modelling
• System dynamics
• Value-chain analysis
Application Of Value Chain Analysis To A Food System
Salmonella in pig food systems

• Salmonella identified as a major food-borne pathogen

• Some food-borne salmonella comes from pig production system

WHERE TO INTERVENE?

• Disease impact

• Risk and uncertainty

• Risk perception and behaviour
Moral hazard

- Actions of one party may lead to the detriment of another
- Occurs when a person takes risks because the cost that could incur will not be felt by them or will be borne primarily by others.

Dealing with businesses and people who need to make a profit for a living (profit thinking)
Basic pig food system

- Provides food for human consumption
- Moves money
- Generates employment
- People in the chains are GEOGRAPHICALLY DISPERSED
  great likelihood of moral hazard

Acknowledgement: Jonathan Rushton
In the pig food system salmonella pathogen:
• can be maintained
• spread in both directions
• be introduced from external sources
How do we achieve sustainable, stable and safe supplies of food?

• **Epidemiology** of health – animals as sentinel beings and risk factors for pathogens
• Context in which diseases circulate – **food system**
• Rules by which people operate – **institutional environment**
• Response of the people concerned – **risk perception** and **behaviour**
• **Uncertainty** – the role of chance in disease events

Acknowledgement: Jonathan Rushton
Thank you for listening!
Useful links and references

• Prowse, Martin and Admos Chimhowu, 2007. Making Agriculture Work for the Poor, Overseas Development Institute, Natural Resource Perspectives 111
• Angrist and Pischke 2008, Mostly Harmless Econometrics: An Empiricist’s Companion
• de Janvry, Dustan and Sadoulet (2010). Recent advances in Impact Analysis Methods for Ex-post Impact Assessments of Agricultural Technology. SPIA, Berkeley
Useful links and references cont....

- “What is health economics?” map: Introduction to Health Economics. London School of Hygiene and Tropical Medicine. Kara Hanson.
- Network for Evaluation of One Health [neoh.onehealthglobal.net/](http://neoh.onehealthglobal.net/)