Economic contribution of research

• Nation’s investment in R&D is key instrument of economic growth
  ➢ U.S. public ag R&D accounts for about half of all agricultural growth since 1950 (Shane et al., 1998)

• Economic payoff to innovator is frequently much lower than benefit society as a whole
  ➢ Social return at least twice the private return (Mansfield, 1977)
Economic returns to research

Has attracted attention of economists since 1950s

- Agricultural sector most heavily studied
  - Returns to research on hybrid corn (Griliches, 1958)
  - Government plays large role in supporting research
  - Relatively good data on R&D spending & productivity change

- Now also have studies on returns to industrial research, basic academic research, health research, etc.
How economists measure returns to research

• Benefit-cost analysis

• Project evaluation method
  – Trace R&D cost and adoption benefits of a specific innovation

• Statistical method
  – Correlate past investments in research with rate of productivity growth
What the “rate of return” means

- Social returns = economic benefit to society
  - higher profits for farms
  - lower costs for consumers
- Internal rate of return (IRR)
  - Discount rate that equates present value of research costs and social benefits from adoption of research outcomes
  - 40% rate of return: $100 invested today generates an annual stream of benefits of $40 into the future
Issues in measuring rate of return to research

• Attribution issues
  – Contribution of private sector and agricultural extension
  – “Spillovers” from research done in other regions

• Lag time
  – When research is done and when its economic effects are felt

• Efficiency losses of tax revenue
  – $1 in government expenditure costs economy more than $1

• Studies have generally not considered some of the consequences of new technology
  – Environmental and health effects
  – Dislocation and adjustment costs
The agricultural research enterprise

United States, 2007
- $5.1 billion in public research
  • Funders: Federal (58%), States (27%), Other (15%)
  • Performers: USDA (25%), State Ag. Exp. Stations (75%)
- $3-4 billion in private research on farm technologies
  • Machinery, chemical, pharmaceutical, biotechnology, food

Worldwide, 2000
- $23 billion in public research
- $10-13 billion in private food & agricultural research

Sources: United States (ERS), Worldwide (Pardey et al., 2006)
What the studies say

Economic returns to the U.S. agricultural research system

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of estimates</th>
<th>Mean estimate</th>
<th>Median estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public ag research</td>
<td>35</td>
<td>53%</td>
<td>45%</td>
</tr>
<tr>
<td>Private ag-related research</td>
<td>4</td>
<td>45%</td>
<td>45%</td>
</tr>
</tbody>
</table>

Source: ERS, based on Huffman and Evenson, 2006.
Distribution of estimates of rate of return to U.S. public ag research
## Economic returns to global agricultural research (public sector)

<table>
<thead>
<tr>
<th>Location of research performer</th>
<th>Number of estimates</th>
<th>Median estimate (% return)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrialized countries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North America</td>
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<td>47</td>
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<tr>
<td>Europe</td>
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<td>62</td>
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<tr>
<td><strong>Developing countries</strong></td>
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<tr>
<td>Africa</td>
<td>188</td>
<td>34</td>
</tr>
<tr>
<td>Multinational</td>
<td>136</td>
<td>37</td>
</tr>
</tbody>
</table>

Source: Alston et al., 2000.
Implications from studies

• High rate of return implies underinvestment in research
• Research returns high for most states and commodities
• Research “spillovers” are significant
• Research benefits widely distributed in economy
  – Most benefits eventually transferred from farm sector to the food industry and consumers in form of lower prices
• Agriculture makes oversized contribution to productivity growth in U.S. economy
  – 1.8% of GDP but 12.1% of total factor productivity growth in U.S economy during 1970-2004 (Jorgenson, 2006)
• Getting a high payoff from research depends on other institutions working properly (markets, industry, extension)