U.S. Agricultural Productivity

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Since 1930s, U.S. agricultural growth entirely from total factor productivity (TFP)

Sources: 1880-1950, Hayami and Ruttan; 1950-2009 ERS
Rate of U.S. agricultural growth gradually slowing

Possible reasons:
- Declining real agricultural prices
- Resources withdrawn from production
- Declining rate of productivity growth

Source: ERS agricultural output series smoothed using Hodrick-Prescott Filter
Quo vadis long-term U.S. agricultural TFP? Competing views

InSTePP (Alston et al.)
- Significant decline in TFP growth rate since 1980s
- Due to stagnation in public R&D investment

ERS (Ball et al.)
- Decline in long-run TFP growth rate not as pronounced
- Trend influenced by business cycles
Since 1950, U.S. agricultural TFP growth has averaged 1.7-1.9% per year

**InSTePP:**
- Higher TFP growth in 1970s-80s shows effects of green revolution
- Slowing of rate of technological change since then

**ERS:**
- Higher TFP growth in 1980s partly due to business cycle
- Farm recession led to withdrawal of least productivity resources

Source: InSTePP and ERS agricultural TFP series smoothed using Hodrick-Prescott Filter ($\lambda=100$)
Differences in TFP measurement mainly due to treatment of agricultural capital

<table>
<thead>
<tr>
<th>InSTePP</th>
<th>ERS</th>
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<tbody>
<tr>
<td>• Capital stock measured by <strong>physical inventory method</strong> (data on current stocks of capital goods)</td>
<td>• Capital stock measured by <strong>perpetual inventory method</strong> (data on past investment in capital goods)</td>
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<tr>
<td>• Capital services priced using constant interest rate</td>
<td>• Capital services priced using market interest rate</td>
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International evidence: PIM capital stock per worker more closely correlated with output per worker

Source: Butzer et al. (2012)
Pricing capital satisfactorily is difficult

- Cost of capital services equilibrium condition: \( c_t = r_t + \delta \)
  
  (cost=interest rate plus depreciation)
But what if capital stock is not in equilibrium? (adjustment to changing conditions takes time)

Sources: Real interest rate is Moody’s corporate bond rate minus change in CPI, both from Federal Reserve. Agricultural capital investment from ERS.
Explanations for long-run growth in TFP

Sources: Agricultural output and TFP from: 1880-1950, Hayami and Ruttan; 1950-2009 ERS
Stagnation in public research investment should slow TFP growth, unless offset by other factors

Sources: Output and TFP from Hayami and Ruttan and ERS; public R&E from Alston.
Possible other factors: Rise in private R&D, advances in basic science, faster technology diffusion and structural change

Sources: Output and TFP from Hayami and Ruttan and ERS, public R&E from Alston; private R&D from ERS.
Conclusions

• Measuring TFP change in agriculture is difficult to do even for countries with very extensive historical data.
• Studies agree that TFP accounts for virtually all agricultural growth in industrialized countries and that “R&D knowledge stocks” account for a large share of this TFP growth.
• Growth in private R&D may have partially offset stagnation in public R&D to keep agricultural TFP growth from slowing.
• But this offers only a temporary respite if public and private R&D these are complementary investments.