Emerging Agricultural Technology, Labor Markets, and Societal Impacts

Dr. Marshall A. Martin
Purdue University
West Lafayette, Indiana

Senior Associate Director of Agricultural Research, Assistant Dean of Agriculture, and Professor of Agricultural Economics

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Beck Agricultural Center
A Century of Change

• Population growth and geographic relocation
• Economic development and growth
• Emerging global society
• Public policy
• Investments in research and technology transfer
Let’s set the stage

- The United States- 1900 to today

5-fold increase

Rural decline from 60% to < 20%
U.S. Economic Development

Long-term real growth in US GDP
GDP adjusted for inflation (2005 dollars) 1871–2009

Labor Productivity
Globalization

- Increased trade
- Instantaneous communication
- Electronic transfer of money
- Weather satellites

- Reallocation of resources
- Greater availability of goods and services
- Increased competition
Public Policy Environment

• Government legislation and regulations - more regulations

• Private sector decisions - consolidation

• Producer and consumer choices - more concerns about how food is produced
Investments in Agricultural Research and Technology Transfer

- Public sector
- Private sector

Increase in private relative to public investment in agricultural research
The Non-Farm Sector Performance

Decline in agriculture, stagnant in industry, and growing in service sector
Beginning in 2000, a widening gap between productivity and private employment showed up in federal labor statistics (indexed: 1947 = 100).

Small gaps between productivity and employment have been seen before.

Job growth suddenly slowed in 2000, while productivity remained robust.
Trends in U.S. Manufacturing Productivity, Output, and Employment: 1987-2010

Note: Increased productivity, stagnant output growth, and lower employment

The manufacturing industry in the U.S. has added more employees with college degrees. The number of workers without degrees has declined.

Shift to higher educated employees
Middle class with lower skills face jobs losses and stagnant wages.
A Century of Technological Change in U.S. Agriculture
Mechanization of Wheat Harvest

1900s

1950s
(2 A/Hr)

Today
(20 A/Hr)
Mechanization of Corn Harvest

1900s

1950s (1.5 A/Hr)

Today (15 A/Hr)
Cotton Harvesting

1900s

Today

1950s

<table>
<thead>
<tr>
<th>Year</th>
<th>Real Wage Rate/Hour</th>
<th>Non-hours Cotton-Labor (millions)</th>
<th>Real Value Output Including Acreage Diversion Payments ($ millions)</th>
<th>Labor Share (P_l)</th>
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<td>1952</td>
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Note: Real wages increased, but hours of labor and labor's share declined.

Fruit Harvest

1900s

1950s

Today
Weed Control

1950s

Today
Milking Cows

1900s

1950s

Today
Farm labor productivity growth faster than nonfarm
Relative Factor Endowments and Technological Change Theory

• The Hayami-Ruttan model of induced innovation

U.S. with 35 people per square mile vs Japan with 348 people per square mile

Historically, Japan has had a relative abundance of labor and U.S. has had a relative abundance of land
Induced Innovation over past Century

- Economic incentives for mechanization in U.S. due to relative labor scarcity
- Economic incentives for yield increasing technologies in Japan due to relative land scarcity
Labor Market Theories

Pull (economic perspective)

*Improved work and quality of life opportunities in urban areas*

Rural urban migration

Better jobs and salaries  |  Health care |  Education
Labor Market Theories

Push (Social perspective)

Social pressures and poor living conditions in rural areas

Rural urban migration

Substandard housing Lack of quality health services Limited educational opportunities
Labor Market Theory

Agriculture Labor Market

Non-Agriculture Labor Market
Substitution of Capital for Labor
Agricultural Technology Adoption: The Treadmill Theory

Farm
AFC - Average Fixed Costs
AVC - Average Variable Costs
ATC - Average Total Costs
MC - Marginal Costs

Market
S - Market Supply
D - Market Demand
Agricultural Technology of Tomorrow

Genomics

Phenotyping

Bioinformatics
Agricultural Technology of Tomorrow

Precision Agriculture

Driver-less tractors

Big Data
Job Loss: Trade Vs Technology

- International trade both expands and reduces employment depending on the sector
  - Fewer low skilled Jobs, but demand for some higher skilled employees

Automotive sector
Job Loss: Trade Vs Technology

• International trade increases competition and offers large choice of cheaper goods
  – Imported consumer goods and intermediary inputs
International trade increases U.S. exports

- Export of U.S. agricultural products

**Agricultural exports**

- Soybean exports 45% U.S. production
- Pork exports 24% U.S. production
Job Loss: Trade Vs Technology

- Technological change increases labor productivity, but requires new skills for many and may increase flow/quantity of product
  - more knowledge based than physical labor based
  - increased volume

Mail and package shipping
Job Loss: Trade Vs Technology

• Challenge is motivating, funding, and providing opportunities for retraining
Breakout Discussion

• What new skill sets will you need on your farm in next 5-10 years?

• How can society best prepare people for these future job opportunities in agriculture?
Breakout Discussion

• What jobs and skill sets do you expect to need in your community/county in next 5-10 years?

• How can society best prepare people for these careers in your county/community?
Questions

marshallmartin@purdue.edu